Methodology of human-geographical researches: contemporary approaches and methods

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ABSTRACT

Problem Statement. Human geography is a science that responds extremely quickly to the new today's demands and challenges. Thanks to the multiplier effect, it has the opportunity to be integrated into a powerful range of contemporary unresolved scientific issues and to propose its approaches to their study and solution based on the robust methodology and development of new research tools. A qualitative new development level of human geography as science in Ukraine and the world requires urgently general rethinking of the prerequisites, goals, and methods of scientific research, the question of the relationship between theoretical and empirical ones in scientific papers. The triune complex "society-nature-economy" and the study of the peculiarities of their interrelationships and contradictions form a wide range of opportunities for human-geographical research.

Research Methodology. The article uses the methods of analysis, synthesis, and dialectical method. The authors have summarized and described the set of original methods of human geography, revealed contemporary approaches and substantiated the peculiarities of the methods of researching the development trajectory of the human-geographical objects, multidimensional spatial analysis and multidimensional classification, spatial interaction of social and geographical objects (IFI modeling), developed and tested by the scientists of the Department of Human Geography and Regional Studies of V. N. Karazin Kharkiv National University.

This paper aims to highlight the methodological foundations of human-geographical research, reveal modern approaches and substantiate the human-geographical approach, and consider the content and features of the use of original methods of human-geographical research. In particular, the coverage of methodological approaches and justification of the human-geographical approach and disclosure of new methods of spatial analysis of the human-geographical process: the study of the spatial interaction of the human-geographical objects (IFI-modelling) and the study of social and geographical systems in the normalized multidimensional space.

Results. The paper describes in detail the possibilities of using original human-geographical methods to solve contemporary issues. A detailed analysis of the application of these methods allows scientists and researchers to use and solve similar or other types of problems effectively.

Scientific novelty and practical significance. The paper presents an exhaustive set of original methods for spatial analysis of the territory and provides an algorithm for their use. The authors provided various human-geographical research areas and tested the original methods.

Keywords: methodology, human geography, original research methods, spatial analysis, multidimensional analysis, an integral function of influence, development trajectory, component analysis.

Problem definition in general and its connection with important scientific and practical tasks (Relevance).

In today's world, given the intensive pace of progress and society's development, it is crucial to study the phenomena comprehensively and processes of

different hierarchical levels. They are both prerequisites and consequences of evolution. Human geography is a science responding extremely quickly to the new requests and challenges of the present due to the wide object and subject of research. Thanks to the multiplier effect, it has the opportunity to be integrated into a powerful range of contemporary unresolved scientific issues and to propose its approaches to their study and solution based on the robust methodology and development of new research tools [27]. A qualitative new development level of human geography as science in Ukraine and the world urgently requires the general rethinking of the prerequisites, goals, and methods of scientific research, the study of the question of the relationship between theoretical and empirical ones in scientific papers. In particular, scientific activism is a highly relevant direction in social and geographical thought movement. This direction defines the role of human geographers as initiators of solving many socio-economic and environmental problems of the XXI century: the issues of war and peace (which are acute for both the world and Ukraine), global migration (it determines the redistribution of labor and resource potential in the world, initiates the processes of "brain drain" and this is a manifestation of globalization processes), stratification of the population and social inequality, development of authoritarianism, impact of the negative environmental situation on public health, the spread of pandemics, etc. The basis for the implementation of the above goals is a robust and diverse theoretical and methodological foundation, a set of methodological principles determining the expansion of the scientific interests of geography in the following areas: cross-sectoral specializations (recreation and tourism, regional development and project work, urbanism and ecology, city-farming), SMART-specialization of cities, GIS (GIS modeling, programming in the software environments of the GIS systems), area management, geodemography, geopolitics, medical geography, the geography of religions, etc.

Thanks to the triune complex "society-nature-economy" and the study of the peculiarities of their interrelationships and contradictions, a wide range of opportunities for human-geographical research is formed. Human geography reveals various issues, such as various aspects of the economic development of specific subjects and areas, regional and district management, transformations and reformation of the administrative structure, peculiarities of self-organization, and self-development of social and geographical systems. This is also spatial development and transformation at the qualitatively new level, based on retrospective analysis, trends in socio-spatial features of development and forecast results, etc. Use a set of philosophical, general scientific, and special methods, including digitalized ones (in particular – geographic information systems and platforms for spatial modeling), provides a verified scientifically based result and determines the use of the methodology of human geography in research activity. It allows using a variety of automated calculations, conducting spatial analysis with further modeling and mapping of their results, and constructing predictive development trajectories by various parameters and scenarios.

Analysis of recent research and publications which have been initiated a solution to the problem raised, on which the author relies; pointing out unresolved part of the problem which the article concerns.

The modern human-geographical methodology is an object of the world scientific discourse, but mostly in solving the applied issues of various research. According to the foreign researchers [2, 10], society is at the center of this world system, which is the root cause of its formation in a familiar form for us. Scientists consider that a significant role in progress and evolution is geographical thinking and comprehension of initial human-geographical categories such as demographic situation, migration processes, local culture, identity, economy, cities and regions, and disparities in spatial development. Modern human-geographical research trends largely highlight the issues of analysis of the political and economic situation as prevailing ones in forecasting the area's long-term development. The current basis of the human-geographical methodology makes it possible to investigate not only particular objects and phenomena but also powerful territorial complexes and geographical networks. It indicates the significant evolution of this basis and intensive development, including through expansion into the spheres of close scientific areas, namely economics, sociology, mathematical statistics, etc. However, this is not a negative phenomenon because each science is enriched and developed by developing and forming specific interdisciplinary methodological techniques.

S. Schollem, M. Lar-Curten et al. have proposed the concept of space and focus on the study of space as an ordered repository of specific and material objects, taking into account their mutual location [12]. They also emphasized the materiality of social life.

Analyzing the authors' position, it is worth noting the debatable question about the role of the absence and presence of the spatial dimension in the constitution of the human-geographical phenomena because it still seems the human geographers insufficiently investigated these issues. An essential task of contemporary human geography is the study of the multidimensionality of space and society's role in forming its new development vectors.

S. Eden, E. Donaldson et al. consider the possi-

bility of using the methodology of the Q analysis in human geography [1]. The authors note that the methodology of human geography has been moving confidently from quantitative to qualitative categories in recent years. The researchers see the category Q in the following: Q subjects of study sort a series of statements (or other materials, indicators) into a grid of numbered columns (from positive to negative integers, and the resulting templates are analyzed then to create a set of standard views on the study topic). The authors consider the formation and processing of this selection as important aspects of this methodology. Once the respondents have sorted the statements, the resulting patterns or "Q-sorting" are analyzed using a combination of computer processing and theoretical interpretation [1]. However, the authors noted the presence of complications in the separation of qualitative/quantitative when using the Q methodology, which determines the error of the obtained result.

The issues of the latest methodology, original techniques, and research methods are revealed by the coryphaeus and the founders of the science, opinion leaders, and influential scientists, whose research is a prerequisite for forming scientific schools (their representatives test and implement the constructed developments).

The representatives of Kyiv, Kharkiv, Lviv, and Odessa scientific schools devoted their papers to developing and improving the modern methodology of domestic human-geographical science.

J. Oliynyk paid considerable attention to the theory and methodology of human geography in studying modern trends of geographical science development [11]. The author considered that the strategic goal of the methodology development of human geography is to determine the geographical shell's economic, demographic, social, political, and environmental capacity at various hierarchical levels. He also considered the goal of the methodology development as justification of the parameters of regional and global environmental management, identification of the main trends of the human-geographical science in general, and individualized. He argued that the problem of developing the domestic methodology of human geography is researchers' activities without formulating a specific goal of implementing their partial contribution to the nationwide school of human geography, world science, and self-identification. It is associated with the simultaneous use of different names of science, such as "economic and social geography", "socio-economic geography", "human geography". As well as, this is the differentiation of human-geographical science and the absence of the system of logically completed laws of science that could integrate different scientific areas, non-realization of the applied function of the human-geographical science, etc.

In the methodological aspect, O. Shabliy focuses on the idea of three types of objects of human geography study: real, conceptual, and virtual, expanding the boundaries of social and geographical space. The scientist developed a functional classification of human-geographical courses and substantiated the main categories of human geography, namely the geospatial organization of society, theories and concepts of the latest areas of human geography (geosphereologists) during the period of global informatization of research activities; classification of natural resources taking into account diverse social needs [32, 19]. O. Shabliy substantiated four types of laws and patterns of human geography: the idea of the flexible geospatial organization of society, changes in the paradigm of the geospatial organization of society with the introduction of IT technologies, especially the URAN and GRID infrastructure networks, etc. [35].

According to O. Topchiev, the methodology and theory of human-geographical science form the concept of the scientific picture of the world [34]. The role of human geography in it is an avant-garde one, because the dynamism of the research object should take into account all new aspects of scientific thinking. The methodology of human geography is essential for developing the theory of science and possibilities of its practical use. According to O. Topchiev, the crucial aspects of the methodology of human geography are ideas about the territorial or spatial structures of geographical phenomena (depending on the dimensionality of the study). The researcher sees the study and settlement of relations in the "society-nature" system as contradictions and debatable issues in developing the human-geographical methodology. He believes it is necessary to form a new scientific area, namely the development of theoretical and methodological principles of the functioning of the landscape shell of the Earth as an integral and complex socio-economic and natural system.

Following K. Mezentsev, the methodology of modern human geography is developed and changed very quickly and determined by the study and analysis of spatial transformations and the evolution of society's economic, political, social, and cultural life. These studies are very important for identifying the opportunities and prospects of ecist, demographic policy, and studying the processes of social polarization. As well as it refers to justifying the prospects for the region's development, taking into account the peculiarities of population settlement, social stratification, new factors. The author notes the need to combine quantitative and qualitative research methods: traditional, innovative, modeling and forecasting development opportunities. K. Mezentsev sees the future development of the methodology of human geography as the broad implementation of nonlinear modeling, neural networks, etc., and the expansion of

the application of perceptual geography, self-identification of the population, etc. [3, 20].

We have already repeatedly considered the problem of the development of human geography and the need to reveal the current and relevant capabilities of the scientific methodology in our research [5, 25-28]. The development of social and geographical systems can be considered as synergy, a process of self-organization and self-development, which opens up new methodological foundations for its research. In particular, the method of modeling the development trajectory in the multidimensional space easily identifies the points of bifurcation and phases of progressive or regressive development of the system. We established a relationship between the spatial distribution of the information entropy of the interaction surface of settlements and the spatial structure of the social and geographical system (in the form of the resettlement system). It can serve as a reliable indicator of the optimal development of the social and geographical system.

Highlighting previously unsolved parts of the general problem devoted to the paper. There is convergence with economics, sociology, political science, etc., in the methodology of contemporary human geography. It promotes the use of methods of related sciences to solve some social issues. The scientific achievements of modern human geography are closely associated with the possibilities of using effective tools developed and improved by basic sciences. The first is mathematics, which contributes to forming a general scientific methodology, new methodological approaches, and methods. This is especially important at the present stage of science development when obtaining new scientific results requires implementing interdisciplinary approaches. The methodological features of human geography, the complexity of its object-subject area, and historical preconditions for its formation have led to its well-developed diverse system of methods, approaches, local theory, and concepts. The features of the object of human geography are the spatial organization of the most semantically general human-geographical process in the different levels of the social and geographical systems. They make it possible to manifest the integrative nature of human geography most vividly [27]. Successful research in one object of interaction and interconnection of natural, social, and economic systems was made possible by the robust methodology of geographical science, in particular, the developed conceptual apparatus and the use of numerous general scientific and special methods of spatial analysis, mathematical and cartographic modeling (including GIS). Following the basic principles of the geographical approach (spatial analysis and complexity of the study), human geography as a dynamic modern branch of classical geography is a robust interdisciplinary science that studies complex socio-economic problems of Geoversum based on the integrated approach.

Formulation of the purpose of the article (setting problem)**. This paper aims** to highlight the methodological foundations of social and geographical research, reveal modern approaches and substantiate the socio-geographical approach, and consider the content and features of using original social and geographical research methods. Achieving this goal is expected through the disclosure of the following research tasks:

- highlighting methodological approaches and justification of the socio-geographical approach;
- disclosure of new methods of spatial analysis of the socio-geographical process
  - study of spatial interaction of social and geographical objects (IFI modeling);
  - research of the social and geographical systems in the normalized multidimensional space:
    - modeling the development trajectory of human-geographical objects;
    - multidimensional classification and diagnosis of system development.

Presentation of the main material of the research. The need for comprehensive consideration of the features of the social and geographical systems requires the use of some methodological approaches which complement each other, namely geographical, systemic, synergistic, informational, and historical ones. Their key elements are the basis of the human-geographical approach [22, 24, 32].

The geographical approach is the primary methodological approach in human geography. It sets two mandatory requirements before any human-geographical study: the complexity of the research and consideration of the object of study in the spatial aspect. These basic requirements of the geographical approach, which characterize the basis of the modern geographical methodology, are implemented in a relatively wide range of special geographical research methods, which will be discussed below.

The historical approach involves the study of geographical objects in development. All phenomena and events are considered spatial processes in time and space. This is of particular importance for the social and geographical systems, given their dynamism and heterogeneity of composition, and makes it possible to determine the historical patterns of the social and geographical process as a whole and its components in particular.

The system approach considers the object of human-geographical research as a large, complex, open, multilevel social and geographical system functioning in a particular environment and interacting with it and other systems. Applying the system approach

involves taking into account all the properties, features, and characteristics of the system.

The synergistic approach involves, first of all, the study of internal interaction in the system, internal resources, and mechanisms that determine the evolutionary potential of the system. The synergistic approach is essential in human-geographical studies because it encourages taking into account the most significant possible number of active factors and processes to cover the functional environment where the processes and phenomena studied occur as widely as possible. Since the social and geographical systems are heterogeneous, complex, and combine different elements and subsystems, the completeness of their consideration is achieved through the study of the internal relationships from the interdisciplinary positions, i.e., from different points of view, which meets the requirements of the synergistic approach. It allows obtaining a holistic and unchanged picture of the interaction of elements and subsystems of the social and geographical system. Therefore, it reliably reproduces the process of its development in general terms or focuses on the most important details. Another feature of the synergistic approach is the following. The system development is considered as a chain of consecutive phase transitions at bifurcation points. Conditions are changed at these points so that the system, adapting, is forced to rebuild its structure and functions, i.e., to change its development trajectory. Therefore, the synergistic approach in human-geographical studies provides the most complete and exhaustive study of complex and ambiguous relationships between different subsystems of the social and geographical system [25].

New (original) methods of human-geographical research.

The task of spatial analysis in human geography is very often reduced to the study of spatial or spatial-time relationships of human-geographical objects. It is necessary, for example, to optimize the spatial structure of various subsystems of the social and geographical systems, organize the systems of the socio-geographic monitoring, solve problems of improving the infrastructure characteristics of the social and geographical systems, study transport and logistics problems, optimize the spatial structure of the location of industrial enterprises and institutions, study migration processes and many other cases. This problem is relevant in all research cases or optimization of the spatial structure of the human-geographical objects or social and geographical systems of different hierarchical levels [22].

It is crucial to introduce new research tools and methods to understand the specifics of the study object of human geography, its everyday complication, and synergistic nature. This research could provide a comprehensive study taking into account the parameters of space and time to perform a retrospective analysis, identify the current state, and forecast prospects for development [24].

Effective methods of studying human-geographical objects are the analysis of spatial interaction of human-geographical objects (in particular, modeling based on the integral function of influence (IFI) and the study of the social and geographical systems in the normalized multidimensional space. It means modeling the development trajectory of the human-geographical objects and multidimensional classification and diagnosis of the system development).

Study of the spatial interaction of the human-geographical objects (IFI modeling). The original techniques of modeling the field of the integral function of influence (IFI-modeling) was developed at V.N. KarazinKharkiv National University [22, 24]. This technique is distinguished by the combination of methods of geographical modeling with methods of approximation of geographic shell fields. The structure of the geospatial data vector involves three components: X and Y coordinates on the horizontal plane and the value of the Z field parameter, namely the "height" of the point. This technique is based on the idea of dividing the field of any parameter into the background and anomalies. A specific feature for any human-geographical unit (when studying resettlement systems) is the radius of the zone of influence, namely the level of its interaction with other objects and the distance from the settlement. The distance depicts the cease of impact of the settlement on the neighboring areas and the loss of the "central place" function of this settlement. The content of this concept can be defined as the radius of the zone, where this object affects any component of the human-geographical process. The interaction of the social and geographical objects depends on the radius of the area of influence. The other component – the attributive one – determines the intensity of interaction, and this is a function of the numerical value of the parameter (power) of object Z.

When determining the radius of the influence area of the settlement, we define it as proportional to the power of the object Z. Given this, the least powerful object should have the smallest radius of influence R0, which can be called the basic one. In contrast, the radius of influence of all other objects can be defined as a derivative function from the base radius. K. Niemets proposed the following dependence to differentiate the human-geographical objects by the magnitude of the radius of influence (formula 1) [22]:

$$R_i = R_0 + k * ln(Z_i/Z_{min}) \qquad (1)$$

where R_i is the radius of influence of ith human-geographical object;

$R0$ – basic radius of influence;

Zi i $Zmin$ is the value of the parameter of i-th and basic objects, respectively;

k is the scaling coefficient.

The intensity of the impact of the socio-geographical object within its area of influence decreases from the center to the periphery. It can be determined as an inverse proportion to the distance to a certain degree. It is advisable to use a non-linear invariant form of the following dependence:

$$\text{at } L \geq R \quad \Delta = 0;$$
$$\text{at } L < R \qquad\qquad\qquad (2)$$

where Δ *is the function of the influence* of the socio-geographical object;

L is the current distance to the center of the influence area of the socio-geographical object;

R is the radius of influence of the socio-geographical object;

n is the exponent, arbitrarily defined.

The following formula determines *the potential of the influence* of the socio-geographical object in the area of influence taking into account the specified dependence:

$$p = Z*\Delta \qquad\qquad (3)$$

where Z is a quantitative parameter (power) of the socio-geographical object (in the center of the zone of influence).

It is expediently to consider the factor of remoteness of the socio- geographical object from the point of view of spatial analysis. Then the possibility of obtaining a service can be represented as a function of the impact of the socio-geographical object. When the user is located in the zone of influence of one socio-geographical object, it is clear that he can use the services of only this object. If the user is situated in the intersection of areas of influence of several socio-geographical objects (in fact, it means their interaction, this is competition in this case), he has a wider choice. Therefore, he is in a better position because he can receive the highest quality or effective service. Extending this conclusion to all types of the socio-geographic objects, it is possible to determine an integral quantitative parameter for each point of the study area, which objectively reflects the user's ability to obtain a particular service. Thus, the researcher creates a model of the field of the integral function of influence (IFI), which can objectively reflect all the peculiarities of the impact and spatial interaction of all similar socio-geographical objects located within the studied territory.

The formula carries out the calculation of IFI taking into account (2):

$$F = \sum_{i=1}^{m} \quad (1 - L_i/R_i)^n \qquad (4)$$

where F is an integral function of influence at a given point in the area;

Li and Ri are the distance and radius of influence of the socio-geographical object;

m is the number of socio-geographical objects that influence a given point.

The relevant integral potential of the influence (IPI) can be determined either by summing the influence potentials of interacting socio-geographical objects:

$$P = \sum_{i=1}^{m} p_i, \qquad\qquad (5)$$

or as a result of calculating the weighted average of the values of their influence function:

$$P = \frac{\sum_{i=1}^{m} p_i * \Delta_i}{\sum_{i=1}^{m} p_i} \qquad\qquad (5a)$$

Thus, the subject of the spatial analysis of the interaction of socio-geographical objects is the surfaces of IFI and IPI. At the same time, each of these surfaces contains its information, which collectively more fully characterizes the spatial nature of the interaction of socio-geographical objects. A characteristic feature of this technique is the possibility of changing the radius of influence of objects: the degree of the surface generalization increases with the increase of this parameter, i.e., its background component is increased and local features (anomalies) are leveled [22]. The choice of the radius of influence determines the level of generalization of the obtained image and the result of the influence of the organizational nuclei of resettlement on their surrounding area and settlements.

The IFI modeling method was tested in studying regional resettlement systems and agglomeration formations. The method allowed to establish the level of influence of organizational nuclei of resettlement on the surrounding settlements, calculate the resettlement potential of local resettlement systems, and identify agglomeration formations and those agglomerations that are only formed or have the resources for this purpose) [7, 9, 17, 18, 23], create IFI models of the use of innovation and investment potential [6, 13], *make* typing of the area of Kharkiv region by demographic and information indicators [29, 31]. As well as *the IFI modeling method fostered to* study the spatial features of the development of the population trading service system of the region (the author analyzed the number of population, trade and restaurant institutions and characterized the ratio of supply and demand) [16].

As an example, we provide the IFI surfaces of the weighted average potential of resettlement of Kharkiv region by the basic radii of influence R0 = 2, 10, 16 and 24 km (Fig. 1). Based on the need to take into account the historically formed features of the interaction of settlements in the resettlement system of the region, we use the method of constructing IFI-models of the surfaces of the demographic potential

fields of the region's settlements. The change in the radius of influence of the object allows tracing the formation of relationships between settlements with increasing interaction forces. It characterizes the actual dynamics of the processes of agglomerations formation, changes in their size and configuration, spatial relations, and intersections. It allows establishing the etiological features of the interconnections studied. We used 993 reference points (settlements of Kharkiv region) in the construction of IFI models and presented the spatial distribution of the integral function of influence (IFI), demographic potential (P), and weighted average demographic IFI potential (Pw) of the resettlement. The selected parameter displays the trends of interaction of settlements. The surface of the influence function with a radius of 2 km demonstrates agglomeration processes of the local level, which characterize the relationships between rural settlements. The administrative centers of this

level are large by the population and economically developed rural-type settlements. Models with a 10-20 km radius manifest agglomeration formations with urban-type settlements as the centers. Models with a radius from 20 km determine the region's main growth poles, namely the region's largest cities with significant human and economic potential. The IFI surface with a radius of 30 km allows tracing the formation of agglomeration axes of the region's resettlement, which are associated with the historical network of resettlement and transport routes that cross the area of the region.

Therefore, an essential aspect of the contemporary human-geographical methodology is comparing and determining the correlation of the dynamics of social and geographical systems (resettlement systems, agglomerations, etc.) in the physical and phase space. The main tool is the structural and systemic analysis of social and geographical systems, high-
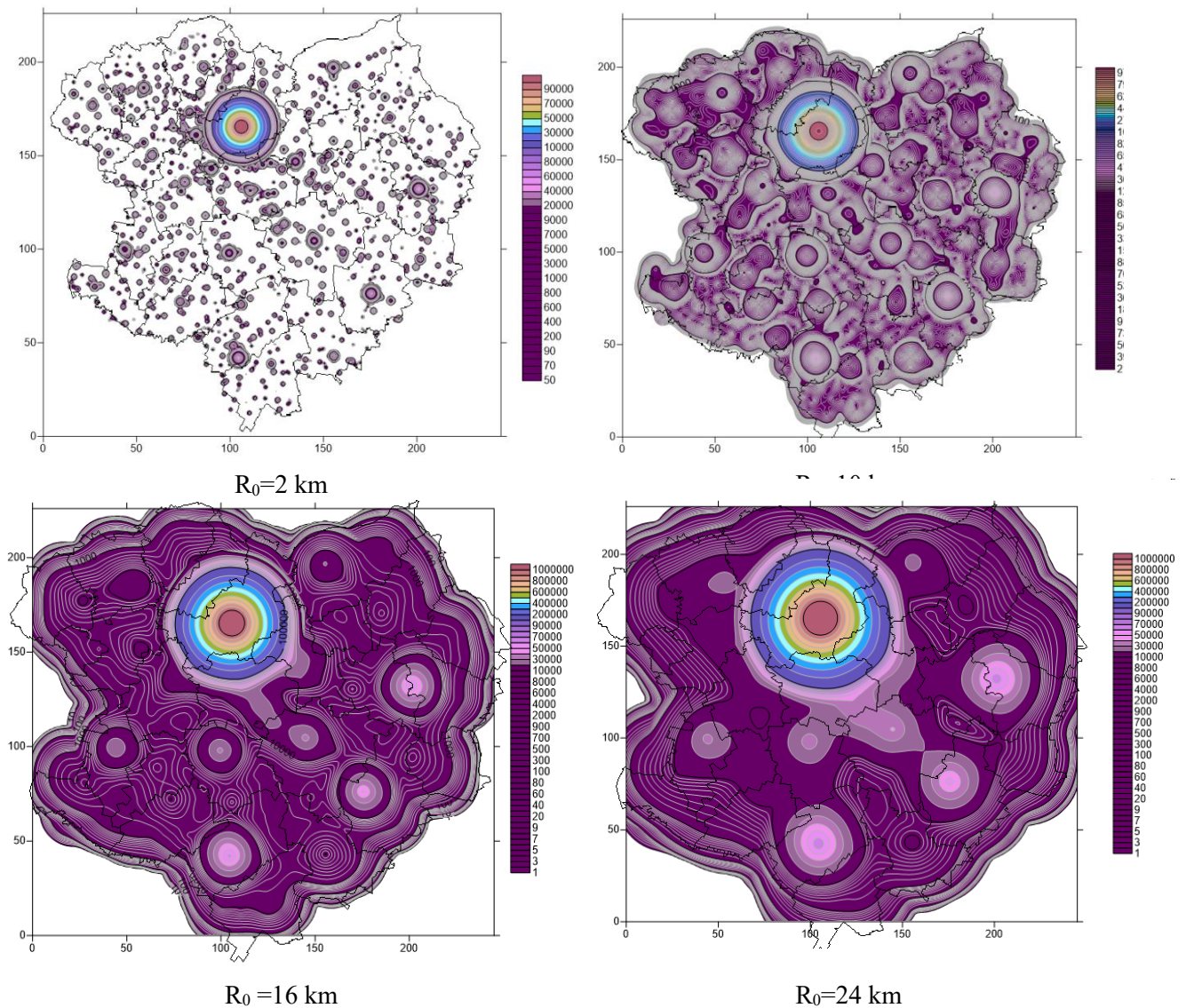

$R_0=2$ km

$R_0=10$ km

$R_0 =16$ km

$R_0=24$ km

Fig. 1. IFI surfaces of the weighted average potential of resettlement of Kharkiv region by the basic radii of influence $R_0 = 2, 10, 16$ and 24 km

lighting zones of different degrees of cooperation according to statistical criteria.

It is worth noting the main methodological directions [22]:

- in the physical space of the IFI-modeling according to different parameters. At the same time, the basic radius of influence determines the criterion of spatial confinement of the social and geographical systems. The usage of the index method allows the transition to a synthetic indicator, namely the sum of indices (in particular, a weighted average index, which is more informative). The IFI surfaces are relatively stable over time (individual elements may occur or disappear, but they are not crucial concerning the overall scheme). Studying such manifestations in the physical space makes it possible to investigate the spatial symmetry (asymmetry) and disproportion of the processes or phenomena studied.

- it is also possible to use the integral influence function with the subsequent construction of the spatial model in the phase space. However, it is almost impossible to "advance in development" and determine anomalies in phase coordinates ("deviations from the optimal trajectory" (using the method of modeling the development trajectory). The content of the constructed elements will be different: firstly, they reflect not physical distances, but the similarity of the state of the components of the system studied; secondly, they are dynamic and demonstrate changes in the state of each element of the social and geographical system at each moment. It allows determining the development vectors of each component in particular and the entire social and geographical system as a whole; thirdly, the basic radius of influence determines the radius of "correlation", i.e., the similarity degree of the elements for each parameter and the synthetic indicator. It is also possible to investigate the state and functional symmetry of the agglomeration.

3. The multifunctional spectrum of possibilities has a semantic analysis of partial IFI surfaces (built based on individual parameters) in physical and phase spaces. In particular, in this plane, it can be possible to search for the correspondence of the "golden intersection" and compare the results, etc.

4. The study of mutual transformations (or unification) of agglomerations images in physical and virtual (phase) spaces will have great creativity and relevance in the future. The solution to this issue is an urgent challenge to the modern world and domestic human-geographical methodological thought.

The given list of methodological provisions allows to solve the main task of the contemporary human-geographical research, namely to find the main patterns in the formation of the spatial and functional structure of social and geograpical systems of different hierarchical levels, determine the criteria for classification, development, stability and readiness to respond to historical challenges, etc.

The research of the social and geographical systems in the normalized multidimensional space. The high level of formalization of the components of the socio- geographical process and the basic concepts of social geography allows using the multidimensional feature space for analysis and synthesis. The formation of its basis on the natural values of the parameters of the socio-geographical objects introduces quite a lot of difficulties associated with different dimensions and a large difference in the intervals of the values of the initial parameters. It is more convenient to use the normalized multidimensional feature space. As a mathematical abstraction, the multidimensional feature space makes it possible to look at the problem of studying the interaction of geographical objects in a completely different way. Among the main research areas, it is worth noting the modeling of the development trajectory of the human-geographical objects and the multidimensional classification and diagnosis of system development [24].

Modeling of the development trajectory of human-geographical objects. The human-geographical process is inherently highly complex because it occurs in significantly heterogeneous social and geographical systems, including natural, social and economic subsystems with different structures, mechanisms of functioning, systems of goals, etc. The synergistic approach is adequate for such a variety of organization of social and geographical systems because it combines the features of the geographical approach (complexity and orientation to spatial analysis) with the contemporary scientific paradigm. The complexity and unpredictability of the socio-geographical objects, caused by the growing predominance of the role of social factors in the development of social and geographical systems, fill the human-geographical research with new content and realities, which determine the leading role of human geography in the future. In particular, we are talking about the fact that modeling methods, using the ideas of synergetics and combined with modern information technologies, make it possible to create fundamentally new scientific objects (models). These models are based on the principles of their conceptual correspondence with the complexity of the human-geographical objects studied. Of course, each model is only a certain approximation to the object (the original). Still, the concept of the model determines the modeling result, particularly its structural and functional features, which should reflect the corresponding characteristics of the original [21, 22, 24]. On the one hand, the completeness of the display of the original on the model depends on the number of operating factors taken into account in the modelling. On the other hand, the increase in the measurability of the

modeling space (increase in the number of operating factors) meets the requirements of the synergistic approach. Therefore, this is one of the real ways to create a fundamentally new concept of modeling the socio-geographical process in the information-human-geographical space [22]. Two sets of indicators determine the movement trajectory of any object: the direction of movement and linear characteristics, for example, the distance traveled by the object over a certain period. The first set of the trajectory indicators includes cosines of angles formed by a segment of the trajectory of the given object with the trajectories of other objects, or specific characteristic directions, for example, an average, optimal, or project trajectory. According to the movement direction indicators, it is possible to evaluate the functioning effectiveness of individual subsystems as part of the more general social and geographical system. The decrease in the angle between the trajectories of the subsystem and the social and geographical system causes the increase of the consistency and, accordingly, the "usefulness" of the subsystem functioning. In the same way, it is possible to assess the consistency of movement (functioning) of subsystems. The growth of the cosine angle between their trajectories indicates convergence of trajectories, which is indisputable proof of the similarity of the subsystem's development.

Two leading quantitative indicators can estimate the movement vector of any object: angular as the movement direction and linear as the speed of movement. This allows comparisons of various objects (social and geographical systems) on these indicators and draws appropriate conclusions. Quantitative parameters of the direction and speed of movement of social and geographical systems make it possible to determine their various characteristics in the aggregate, depending on the purpose and objectives of the study. Firstly, we consider the criterion of the movement direction, the cosine of the angle between the trajectories display this indicator. The direction of the real trajectory should be determined relatively to a certain basic trajectory (for example, the ideal development trajectory). The cosine can be defined for *a j*th object by the following dependence [24]:

$$cos\ \alpha_j = \frac{\sum_{i=1}^{N}(K_{Tr,i,k} - K_{Tr,i,0}) * (K_{j,i,k} - K_{j,i,0})}{\sqrt{\sum_{i=1}^{N}(K_{Tr,i,k} - K_{Tr,i,0})^2} * \sqrt{\sum_{i=1}^{N}(K_{j,i,k} - K_{j,i,0})^2}} \quad (6)$$

where **KTr,i,k** and **KTr,i,0** are *i*th coordinates of the end and starting point of the base trajectory vector;

where **Kj,i,k** and **Kj,i,0** are *i*th coordinate of the end and starting point of the real trajectory vector;

Testing of the modeling method of the development trajectory of the human-geographical objects was carried out in the study of the social infrastructure of Kharkiv region [4], the development

dynamics of the system of the population trading service of Kharkiv region [14, 16], the structure of models of socio-economic development [33] and formation of the competitiveness of the region [13], modeling the dynamics development of the geodemographic system [8, 28-31].

Multidimensional classification of the social and geographical systems according to the development state. The problem of the classification of the social and geographical systems by the movement in the analytical space (social and geographical process (development) requires distinguishing between two fundamentally different formulations of the problem [24]. The first case concerns the classification of the social and geographical systems according to the development state at a certain (control or calculated) point in time, i.e., the time slice of the development process at a fixed time point. This classification makes it possible to simultaneously identify and compare the state of the social and geographical systems, just as a flash of lightning records the location of all objects moving around at night. Thus, leaders and outsiders of the movement (development) can be identified to adopt certain conclusions and appropriate measures concerning lagging the social and geographical systems. Consequently, the classification of this type is relevant and necessary. At the same time, it is static and does not carry any information about changes in the pace of development of individual social and geographical systems. This shortcoming is corrected by analyzing two consecutive static states of the social and geographical systems when solving the classification problem in the second formulation, namely according to the development dynamics. In this case, the researchers compare two (or more) consecutive time slices of the development process and conclude their development's pace for a certain (control or estimated) period. Various linear characteristics of the trajectory represent the set of indicators. It means distances in the multidimensional space, which characterize the path traveled by the object in a certain time, or the distance from the current point of the trajectory (at the given time) to the characteristic points in the space (from the origin of coordinates, the midpoint of the social and geographical system or the point of the maximum development). Depending on the purpose of the study, the following linear indicators of the trajectory can be determined [24]:

- the path traveled by the social and geographical system in the multidimensional feature space (MFS) (ΔL) is the Euclidean distance between the trajectory points at adjacent time points. This is a dynamic characteristic of the trajectory because its length indicates the intensity of the movement of the social and geographical system;

- the speed of movement is the ratio of the length of the traveled path to the time interval between adjacent calculated moments ($\Delta L/\Delta t$);

- the distance of the current trajectory point from the point of minimum development (origin of coordinates) (L0), which assesses the movement effectiveness of the social and geographical system. The more effective social and geographical system will be more distant from the starting position in an equal time;

- the distance from the current point of the trajectory to the point of maximum development (end point) (L1) characterizes the movement effectiveness of the social and geographical system. The more effective social and geographical system will reach sooner or come closest to the highest indicator;

- the difference in the path remaining to go to the point of the maximum development (L1) and the path passed (L0), which gives an idea of the movement pace of the social and geographical system in the multidimensional space. The decrease in this indicator defines a faster movement of the social and geographical system;

- the progress coefficient is the ratio L0/L1, which is also a relative assessment of the development effectiveness of the social and geographical system in the normalized MFS, because the growth of this parameter indicates faster progress of this social and geographical system.

In our opinion, analysis of the projections of the movement vectors of the social and geographical systems on the main diagonal of the hypercube of the normalized MFS is promising. It gives a direct quantitative assessment of their development dynamics.

The criterion of the speed of movement of the social and geographical system in a multidimensional feature space makes it possible to analyze the linear characteristics of their trajectories, for example, the path traveled in a particular time, the distance from the current point to the start point and the point of the maximum development, the speed of movement, the characteristic ratios of trajectories, etc.

The path traveled by a given social and geographical system over some time can be defined as the Euclidean distance between two successive points in time of the trajectory:

$$L = \sqrt{\sum_{i=1}^{N}(X^t_i - X^{t+\Delta t}_i)^2} \qquad (7)$$

where X^t_i, $X^{t+\Delta t}_i$ is **ith** coordinate of space, respectively, at the moments of time t and $t+\Delta t$ (the beginning and end points of the segment of the trajectory of the social and geographical system);

N is the measurability of the space.

The total path traveled by the social and geographical system in the MFS can be defined as the sum of the Euclidean distances between all successive points of its trajectory:

$$P_{\text{int}} = \sum_{j=1}^{Mt} L_j \qquad (8)$$

where L_j is the Euclidean distance traveled by the social and geographical system at jth segment of the trajectory;

Mt is a number of estimated moments in time.

Knowing the time T which the object travels the total distance, it is possible to determine the average speed of movement of the social and geographical system:

$$V_t = P_{int}/T \qquad (9)$$

The movement speed of the social and geographical system in a multidimensional feature space characterizes its development's dynamism (pace).

When determining the total path, it is also necessary to consider the direction of movement. It is advisable to project the total path (or its components) on the ideal or control trajectory of movement $P_{int,pr}$. According to this, it is possible to identify the productive (effective) movement speed of the social and geographical system:

$$V_{tef} = P_{int,pr}/T \qquad (10)$$

Therefore, the modeling of the development trajectory of the social and geographical system intends to determine the movement vectors of the social and geographical system and its subsystems at each calculation point of the trajectory in the multidimensional space (its components are the cosine of angle and speed of movement). Complementing the trajectory vectors with the above indicators, it is possible to determine the differences between subsystems and the efficiency of their functioning as part of the social and geographical system.

Testing of the method of the multidimensional classification of the social and geographical system according to the state of development was carried out when determining the development degree of the system of population trading service in Kharkiv region [15, 16], the features of the socio-economic development [33] and assessing the competitiveness of cities and districts of Kharkiv region [13], establishing the strengths and weaknesses of geodemographic development [28-31].

As an example, we provide the typing of cities and districts of Kharkiv region by the features of the development trajectory of geodemographic systems (Fig. 2). The distribution of districts of Kharkiv region according to the dev elopment trajectory of their geodemographic systems on the phase plane demonstrated that the best trends in the geodemographic process are observed in the Kharkiv district. The next are Dergachi district and a relatively dense group of most districts of the region. The development trajectory of the geodemographic system has a pronounced non-equilibrium character. There are years with both

positive and negative dynamics, which constantly change each other during the studied period. The most threatening situation concerning the functioning and development of the geodemographic system occurred in Pechenizky, Kolomatsky, Pervomaysky, Iziumsky, Shevchenkivsky and Kegichivsky districts, as well as in the city of Izium, which manifest the predominant regressive nature of the development of geodemographic systems [31].

The application of the multidimensional classification, in particular, the component analysis of the development vector of the social and geographical system is an important, effective tool for determining

the development problems and formation of scientifically substantiated measures for their leveling, which proved in several studies [4,9,13,16,24,31,33].

Conclusions. The article presents the methodological foundations of human-geographical research, reveals contemporary approaches, and substantiates the features of methods for studying the development trajectory of the human-geographical objects, multidimensional spatial analysis and multidimensional classification, developed and tested by scientists of the Department of Human Geography and Regional Studies of V.N. KarazinKharkiv National University over the past 15 years, provides examples of their ap-
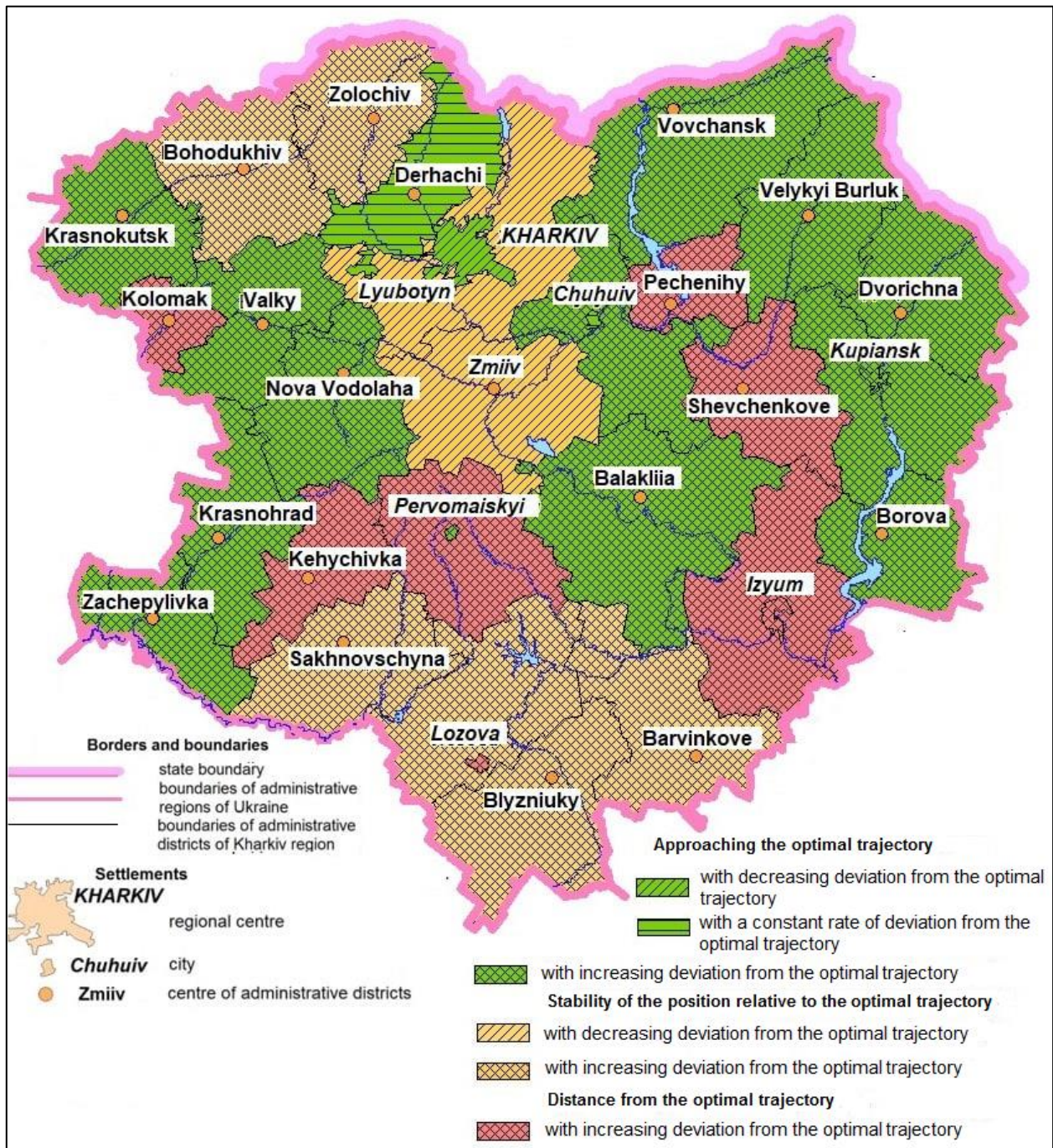

Fig. 2. Typing of cities and districts of the Kharkiv region according to the features
of the development trajectory of geodemographic systems [33]

plication. Based on the understanding of the need to apply a human-geographical approach, which includes elements of the system, synergetic, information, historical ones, etc., the basis of human-geographical research is the concept of the human-geographical process in the multidimensional feature space. The authors have disclosed new methods of spatial analysis of the human-geographical process, in particular, the study of the spatial interaction of the humam-geographical objects (IFI-modeling); research of the social and geographical systems in the normalized multidimensional space (modeling the development trajectory of human-geographical objects and multidimensional classification and diagnosis of system development). Also they provided the application results of the methods mentioned above for the study of the dynamics of functioning and development, monitoring and social management.

Certainly, it is the improvement of the existing methodology of human geography and the development of new research methods and approaches which are the catalyst for the development of science. The development of the interdisciplinary methodology can be considered one of the ways of improving the research methods and approaches. It allows seeing the research object "from a different angle", but it is mandatory to consider the peculiarities and specifics of human-geographical research: dynamism, presence of the spatial aspect, and complexity. At the same time, a combination of such complex objects of research in human geography as "society-economy-nature" draws attention to the fact that the modern methodology of human geography should cover all three components and provide the possibility of analyzing relationships and interactions. The proposed original research methods allow performing an analysis taking into account aspects and factors of various kinds and etiology to regulate the degree of influence. They assess not only objects but also the links between them. It allows ensuring the complexity of the study.

Bibliography

1. *Eden S. Structuring subjectivities? Using Q methodology in human geography. / S. Eden, A. Donaldson, G. Walker // Area, 2005. – No 37.4. – P. 413–422.*
2. *Erin H., Fouberg A., Murphy B. Human Geography: People, Place, and Culture, 12th Edition, 2020. - 512 p. [Електронний ресурс]. – Режим доступу: https://www.wiley.com/en-us/Human+Geography:+People,+Place,+and+Culture,+12th+Edition-p-9781119577539*
3. *Mezentsev K. Challenges of the Post-Soviet Development of Ukraine: Economic Transformations, Demographic Changes and Socio-Spatial Polarization / K. Mezentsev, G. Pidgrushnyi, N. Mezentseva // In: Lang, T., Henn, S., Sgibnev, W., Ehrlich, K. (eds) Understanding Geographies of Polarization and Peripheralization. New Geographies of Europe. Palgrave Macmillan. – London, 2015. DOI: https://doi.org/10.1057/9781137415080_14*
4. *Nemets L. M. Analysis of development trajectory for social infrastructure of Kharkiv region / L. M. Nemets, P. O. Kobylin, K. Y. Segida // Actual Problems of Economics. – 2014. – No 161(11). – P. 409-418. – Режим доступу: https://eco-science.net/downloads/*
5. *Niemets K. Some issues of the methodological status of human geography in the context of interdisciplinary research / K. Niemets, L. Niemets, K. Sehida, L. Kliuchko, I. Telebienieva // Регіон 2019: стратегія оптимального розвитку: матеріали міжнародної науково-практичної конференції [Харків], 16-18 жовтня 2019 р. / ХНУ імені В. Н. Каразіна. – Харків, 2019. – С. 17-22.*
6. *Niemets L. M. Innovation and investment potential of region as a factor of its "smart transformation" –a case study of Kharkiv region (Ukraine)/ L. M. Niemets, K. V. Mezentsev, K. Y. Sehida, C. Morar, N. V. Husieva, V. A. Peresadko, I. Y. Telebienieva // Visnyk of V.N. Karazin Kharkiv National University, series "Geology. Geography. Ecology", 2018. – Issue 49. – P. 137-159. DOI: https://doi.org/10.26565/2410-7360-2018-49-11*
7. *Niemets L. Transition Features To The Policentric Development Of The Region: Technique And Practice Of The Research / L. Niemets, K. Niemets, K. Kravchenko, L. Kliuchko, P. Kobylin // Proceedings of the 33rd International Business Information Management Association Conference (2019, 10-11 April Granada, Spain). – P. 3093-3101 [Електронний ресурс]. – Режим доступу: https://ibima.org/accepted-paper/transition-features-to-the-policentric-development-of-the-region-technique-and-practice-of-the-research/*
8. *Нємець Л. Демографічний розвиток Харківського регіону / Л. Нємець, К. Нємець, К. Сегіда. – ХНУ імені В. Н. Каразіна. – Харків: 2012. – 200 с.*
9. *Niemets, L. Trends Forming Policentric Model of Space Development and Implementation of the World Experience for Ukraine / L. Niemets, K. Sehida, K Kravchenko, I. Telebienieva, V. Peresadko // Proceedings of the 32nd International Business Information Management Association Conference (2018, November 15-16, Seville, Spain,). – P. 362-374 [Електронний ресурс]. –Режим доступу: https://ibima.org/accepted-paper/trends-forming-policentric-model-of-space-development-and-implementation-of-the-world-experience-for-ukraine/*
10. *Norton W. Human Geography / Norton, William, Mercier, Michael // OUP Catalogue, Oxford University Press, edition 9. – 2016. [Електронний ресурс]. – Режим доступу: https://ideas.repec.org/b/oxp/obooks/9780199019557.html*
11. *Dialogues in Human Geography [Електронний ресурс]. – Режим доступу: https://journals.sagepub.com/home/dhg 1119577539*

12. *Oliinyk Ya. B. Trends in the development of geographic science / Ya. B. Oliinyk // Economic and social geography. – 2016, No. 75. – P. 3-6.*

13. *Scholl, S., Lahr-Kurten, M., & Redepenning, M. Considering the role of presence and absence in space constructions: ethnography as methodology in human geography / M. Lahr-Kurten & M. Redepenning // Historical Social Research, 2014. – 39(2), 51-67. https://doi.org/10.12759/hsr.39.2014.2.51-67*

14. *Інноваційно-інвестиційний потенціал як основа конкурентоспроможності регіону (на прикладі Харківської області): монографія / [Л. М. Нємець та ін.]; – ХНУ імені В. Н. Каразіна. – Харків: 2017. – 520 с.*

15. *Кобилін П. О. Просторово-часовий аналіз торговельного обслуговування населення Харківської області за параметрами траєкторії руху соціогеосистем / П. О. Кобилін // Вісник Харківського національного університету імені В. Н. Каразіна. Серія «Геологія. Географія. Екологія». – 2016. – No 44. – С. 88-97. – Режим доступу: http://journals.uran.ua/geoeco/article/view/86442*

16. *Кобилін П. О. Суспільно-географічне дослідження сфери торгівлі Харківської області за показниками системного розвитку / П. О. Кобилін // Часопис соціально-економічної географії. – 2016. – No 20(1). – С. 154-165. – Режим доступу: http://hgj.univer.kharkov.ua/index.php/ru/archive-2/20-1-2016*

17. *Кобилін П. О. Територіальні особливості системи торговельного обслуговування населення Харківської області : дис. ... канд. геогр. наук : 11.00.02 / П. О. Кобилін. – Харків, 2017. – [Електронний ресурс]. – Режим доступу: http://soc-econom-region.univer.kharkov.ua/wp-content/uploads/2017/07/%D0%9A%D0%BE%D0%B1%D0%B8%D0%BB%D1%96%D0%BD_%D0%B4%D0%B8%D1%81%D0%B5%D1%80%D1%82%D0%B0%D1%86%D1%96%D1%8F.pdf*

18. *Кравченко К. О. Суспільно-географічні особливості формування та розвитку системи розселення Харківської області : дис. ... канд. геогр. наук : 11.00.02 / К. О. Кравченко. – Харків, 2018. [Електронний ресурс]. – Режим доступу: http://soc-econom-region.univer.kharkov.ua/wp-content/uploads/2017/07/На-сайт_Дисертаційна-робота-Кравченко-К.О..pdf*

19. *Кравченко К. Methods and approaches of determining the boundaries of agglomerations (basic case Kharkiv region) / К. Кравченко, К. Нємець, К. Сегіда, Л. Нємець, О. Суптело // Часопис соціально-економічної географії. – 2020. – No 28. – С. 5-16. DOI: https://doi.org/10.26565/2076-1333-2020-28-01*

20. *Маруняк Є. О. Соціально-економічний простір (методологія геопросторових досліджень та практика планування) : дис. ... докт. геогр. наук 11.00.02 / Є. О. Маруняк. – Київ, 2016. – 503 с.*

21. *Мезенцев К. В. Методи дослідження в суспільній географії: традиції і новації / К. В. Мезенцев // Економічна та соціальна географія. – 2013. – No 1. – С. 32-42.*

22. *Нємець К. Моделювання траєкторій у багатовимірному просторі: суспільно-географічна інтерпретація / К. Нємець, Л. Нємець, К. Сегіда, Є. Телебєнєва, К. Кравченко // Часопис соціально-економічної географії. – 2018. – No 25. – С. 41-53. DOI: https://doi.org/10.26565/2076-1333-2018-25-04*

23. *Нємець К. А. Просторовий аналіз у суспільній географії: нові підходи, методи, моделі: монографія / К. А. Нємець, Л. М. Нємець; – ХНУ імені В. Н. Каразіна. – Харків: 2013. – 228 с.*

24. *Нємець К. А. Дослідження міських агломерацій в аспекті реалізації адміністративно-територіальної реформи в Україні (на прикладі Харківської області) / К. А. Нємець, К. Ю. Сегіда, Л. М. Нємець, Є. Ю. Телебєнєва, Л. В. Ключко, В. І. Редін // Часопис соціально-економічної географії. – 2019. – No 27. – С. 28-39. DOI: https://doi.org/10.26565/2076-1333-2019-27-04*

25. *Нємець К. Багатовимірний аналіз у суспільній географії (нетрадиційні методи): монографія / К. Нємець, К. Сегіда, Л. Нємець; – ХНУ імені В. Н. Каразіна. – Харків: 2016. – 120 с.*

26. *Нємець К. А. Синергетичні засади суспільно-географічного дослідження / К. А. Нємець, Л. М. Нємець // Регіон – 2017: стратегія оптимального розвитку: матеріали міжнародної науково-практичної конференції [Харків], 19-20 вересня 2017 р. / ХНУ імені В. Н. Каразіна. – Харків, 2017. – С. 9-12. – Режим доступу: http://soc-econom-region.univer.kharkov.ua/wp-content/uploads/2017/07/Збірник_Регіон-2017.pdf*

27. *Нємець Л. Постіндустріальний розвиток суспільства і роль суспільної географії / Л. Нємець, К. Сегіда, К. Нємець // Регіон – 2021: стратегія оптимального розвитку: матеріали міжнародної науково-практичної конференції [Харків], 21-22 жовтня 2021 р. / ХНУ імені В. Н. Каразіна. – Харків, 2021. – С. 13-17. – Режим доступу: http://soc-econom-region.univer.kharkov.ua/wp-content/uploads/2017/07/Збірник-Регіон-2021-1.pdf*

28. *Нємець Л. М. Сучасна соціальна географія: аналіз стану, проблеми та перспективи / Л. М. Нємець // Часопис соціально-економічної географії. – 2012. – No. 13(2). – 2012. – с. 14-20.*

29. *Сегіда К. Суспільно-географічна концепція геодемографічної системи регіону / К. Сегіда // Часопис соціально-економічної географії. – 2017. – No. 22 (1). – С. 53-61 DOI: https://doi.org/10.26565/2076-1333-2017-22-09*

30. *Сегіда К. Ю. Оціночно-прогностичне моделювання геодемографічної системи Харківського регіону / К. Ю. Сегіда // Вісник Харківського національного університету імені В. Н. Каразіна. Серія «Геологія. Географія. Екологія». – 2017. – No 46. – С. 136-145. DOI: https://doi.org/10.26565/2410-7360-2017-46-19*

31. *Сегіда К. Ю. Суспільно-географічна концепція геодемографічної системи регіону : дис. ... док. геогр. наук : 11.00.02 / К. Ю. Сегіда. – Київ, 2017. [Електронний ресурс]. – Режим доступу: http://scc.univ.kiev.ua/upload/iblock/87b/dis_Sehida%20K.Y._new.pdf*

32. *Соціальна географія: підручник / [за ред. Л. Нємець, К. Мезенцева]. – Київ, 2019. – 304 с.*

33. *Телебєнєва Є. Ю. Суспільно-географічне дослідження соціально-економічного розвитку регіону (на прикладі Харківської області) : дис. ... канд. геогр. наук : 11.00.02 / Є. Ю. Телебєнєва. – Харків, 2015. [Електронний*

ресурс]. – *Режим доступу:* http://soc-econom-region.univer.kharkov.ua/wp-content/uploads/2017/07/Dis-ertatsiyna_robota_Telebyenyevoyi_Ye_Yu.pdf

34. *Топчієв О. Г. Суспільно-географічні дослідження: методологія, методи, методика: Навчальний посібник / О. Г. Топчівєв. – Одеса, 2005. – 632 с.*

35. *Шаблій О. І. Основи суспільної географії: Підручник / О. І. Шаблій. – ЛНУ імені Івана Франка. – Львів, 2012. – 296 с.*

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References

1. *Eden, S., Donaldson, A., Walker, G. (2005). Structuring subjectivities? Using Q methodology in human geography. Area 37.4, 413-422.*

2. *Erin, H., Fouberg, A., Murphy B. (2020). Human Geography: People, Place, and Culture, 12th Edition, 512. Available at:* https://www.wiley.com/en-us/Human+Geography:+People,+Place,+and+Culture,+12th+Edition-p-9781119577539

3. *Mezentsev, K., Pidgrushnyi, G., Mezentseva, N. (2015). Challenges of the Post-Soviet Development of Ukraine: Economic Transformations, Demographic Changes and Socio-Spatial Polarization. Understanding Geographies of Polarization and Peripheralization. New Geographies of Europe. DOI:* https://doi.org/10.1057/9781137415080_14

4. *Nemets, L., Kobylin, P., Segida, K. (2014). Analysis of development trajectory for social infrastructure of Kharkiv region. Actual Problems of Economics, 161 (11), 409-418.*

5. *Niemets K., Niemets L., Sehida K., Kliuchko L., Telebienieva I. (2019). Some issues of the methodological status of human geography in the context of interdisciplinary research. Region 2019: optimal development strategy. International Scientific and Practical Conference. Kharkiv, 17-22.*

6. *Niemets, L., Mezentsev, K., Morar, C., Sehida, K., Husieva, N., Peresadko,V. (2018). Innovation and Investment Potential of Region as a Factor of its" Smart Transformation": Kharkiv Region Case Study (Ukraine). Visnyk of V. N. Karazin Kharkiv National University, series "Geology. Geography. Ecology", 49, 137-159. DOI:* https://doi.org/10.26565/2410-7360-2018-49-11

7. *Niemets, L., Niemets, K., Kravchenko, K., Kliuchko, L., Kobylin, P. (2019). Transition Features to the Policentric Development of the Region: Technique and Practice of the Research. Proceedings of the 32nd International Business Information Management Association Conference (April 10-11, 2019, Granada, Spain), 3093-3101. Available at:* https://ibima.org/accepted-paper/transition-features-to-the-policentric-development-of-the-region-technique-and-practice-of-the-research/

8. *Niemets, L., Niemets, K., Segida, K. (2012). Demografichny`j rozvy`tok Xarkivs`kogo regionu [Demographic development of Kharkiv region]. Kharkiv, Ukraine, V.N. Karazin Kharkiv National University, 200 [in Ukrainian].*

9. *Niemets, L., Sehida, K., Kravchenko, K., Telebienieva, I., Peresadko, V. (2018). Trends Forming Policentric Model of Space Development and Implementation of the World Experience for Ukraine. Proceedings of the 32nd International Business Information Management Association Conference (November 15-16, 2018, Seville, Spain,), 362-374. Available at:* https://ibima.org/accepted-paper/trends-forming-policentric-model-of-space-development-and-implementation-of-the-world-experience-for-ukraine/

10. *Norton, William & Mercier, Michael, (2016). «Human Geography» OUP Catalogue, Oxford University Press, edition 9. Available at:* https://ideas.repec.org/b/oxp/obooks/9780199019557.html

11. *Dialogues in Human Geography. Available at:* https://journals.sagepub.com/home/dhg *1119577539*

12. *Oliinyk, Ya. B. (2016). Tendentsii rozvytku heohrafichnoi nauky [Trends in the development of geographic science]. Economic and social geography. Vol. 75. 3-6.*

13. *Scholl, S., Lahr-Kurten, M., & Redepenning, M. (2014). Considering the role of presence and absence in space constructions: ethnography as methodology in human geography. Historical Social Research, 39(2), 51-67. DOI:* https://doi.org/10.12759/hsr.39.2014.2.51-67

14. *Niemets, L., Sehida, K. (Eds) (2017). Innovative-investment potential as the regional competitiveness base (a case study of Kharkiv region). Kharkiv, V. N. Karazin Kharkiv National University, 520 [in Ukrainian]*

15. *Kobylin, P. O. (2016). Prostorovo-chasovyi analiz torhovelnoho obsluhovuvannia naselennia Kharkivskoi oblasti za parametramy traiektorii rukhu sotsioheosystem [Spatial and temporal analysis of population trade service in Kharkiv region for parameters of social and geographical system trajectory motion]. Visnyk of V. N. Karazin Kharkiv National University, series "Geology. Geography. Ecology", 44, 88-97. Available at:* https://periodicals.karazin.ua/geoeco/article/view/7497*[in Ukrainian]*

16. *Kobylin, P. O. (2016). Suspilno-heohrafichne doslidzhennia sfery torhivli Kharkivskoi oblasti za pokaznykamy systemnoho rozvytku [Human-geographical research of the trading sphere of Kharkiv region based on indicators of system development] Human Geography Journal. 20, 154-165. Available at:* http://hgj.univer.kharkov.ua/index.php/ru/archive-2/20-1-2016 *[in Ukrainian]*

17. *Kobylin, P. O. (2017). Terytorialni osoblyvosti systemy torhovelnoho obsluhovuvannia naselennia Kharkivskoi oblasti [Territorial features of the system of the population trading service in Kharkiv region]. Phd's thesis. Karazin Kharkiv National University, 386 [in Ukrainian]*

18. *Kravchenko, K. O. (2018). Suspilno-heohrafichni osoblyvosti formuvannia ta rozvytku systemy rozselennia Kharkivskoi oblasti [Human-geographical features of the formation and development of the resettlement system of Kharkiv region] Phd's thesis. Karazin Kharkiv National University, Available at: http://soc-econom-region.univer.kharkov.ua/wp-content/uploads/2017/07/На-сайт_Дисертаційна-робота-Кравченко-К.О..pdf [in Ukrainian]*

19. *Kravchenko, K., Niemet.s K., Sehida. K., Niemets. L., Suptelo O. (2020). Methods and approaches of determining the boundaries of agglomerations (basic case of Kharkiv region). Human Geography Journal, 28, 5-16. DOI: https://doi.org/10.26565/2076-1333-2020-28-01*

20. *Maruniak Ye. O. (2016). Sotsialno-ekonomichnyi prostir (metodolohiia heoprostorovykh doslidzhen ta praktyka planuvannia) [Socio-economic space (methodology of geospatial research and planning practice)]. Doctor's thesis. Kyiv. P. 503 [in Ukrainian]*

21. *Mezentsev, K. V. (2013) Metody doslidzhennia v suspilnii heohrafii: tradytsii i novatsii [Research methods in human geography: traditions and innovations] Economic and Social Geography1, 32-42 [in Ukrainian]*

22. *Niemets, K., Niemets, L., Sehida, K., Telebienieva, Ye., Kravchenko, K. (2018) Modeliuvannia traiektorii u bahatovymirnomu prostori: suspilno-heohrafichna interpretatsiia [Modeling of development trajectories in the multidimensional space: human-geographical interpretation] Human Geography Journal. 25, 41-53. DOI: https://doi.org/10.26565/2076-1333-2018-25-04 [in Ukrainian]*

23. *Niemets, K. A., Niemets, L. M. (2013). Prostorovyi analiz u suspilnii heohrafii: novi pidkhody, metody, modelii: monograph [Spatial analysis in human geography: new approaches, methods, models] Kharkiv, V.N. Karazin Khrakiv National University, 228 [in Ukrainian]*

24. *Niemets, K. A., Sehida, K. Yu, Niemets, L. M., Telebieneva, Ye. Yu, Kliuchko, L. V., Redin V. I. (2019). Doslidzhennia miskykh ahlomeratsii v aspekti realizatsii administratyvno-terytorialnoi reformy v Ukraini (na prykladi Kharkivskoi oblasti) [Research of urban agglomerations in the aspect of implementation of the administrative and territorial reform in Ukraine (case study of Kharkiv region)]. Human Geography Journal. 27, 28-39. DOI: https://doi.org/10.26565/2076-1333-2019-27-04 [in Ukrainian]*

25. *Niemets, K. A., Sehida, K. Yu., Niemets, L. M. (2016). Bahatovymirnyy analiz u suspil'niy heohrafiyi (netradytsiyni metody) [Multidimensional analysis in human geography (non-traditional methods)]: monograph, Kharkiv, V. N. Karazin Khrakiv National University, 120 [in Ukrainian]*

26. *Niemets, K. A., Niemets, L. M. (2017). Synerhetychni zasady suspilno-heohrafichnoho doslidzhennia [Synergistic principles of human-geographical research] Region 2017: Optimal Development Strategy. International Scientific and Practical Conference. Kharkiv. 9-12. Available at: http://soc-econom-region.univer.kharkov.ua/wp-content/uploads/2017/07/Збірник_Регіон-2017.pdf [in Ukrainian]*

27. *Niemets, L., Sehida, K., Niemets, K. (2021). Postidustrialnyi rozvytok suspilstva i rol suspilnoi heohrafii [Post-industrial development of society and the role of humanl geography] Region 2021: Optimal Development Strategy. International Scientific and Practical Conference. Kharkiv 13-17. Available at: http://soc-econom-region.univer.kharkov.ua/wp-content/uploads/2017/07/Збірник-Регіон-2021-1.pdf [in Ukrainian]*

28. *Niemets, L. M. (2012). Suchasna sotsialna heohrafiia: analiz stanu, problemy ta perspektyvy [Modern social geography: analysis of the state, problems and prospects] Human Geography Journal. 13 (2), 14-20.*

29. *Sehida, K. (2017) Suspilno-heohrafichna kontseptsiia heodemohrafichnoi systemy rehionu [Human-geographical concept of the regional geodemographic system] Human Geography Journal. 22 (1), 53-61, DOI: https://doi.org/10.26565/2076-1333-2017-22-09 [in Ukrainian]*

30. *Sehida, K. Yu. (2017). Otsinochno-prohnostychne modeliuvannia heodemohrafichnoi systemy Kharkivskoho rehionu [Assessment and prognostic modeling of the geodemographic system of Kharkiv region]. Visnyk of V. N. Karazin Kharkiv National University, series "Geology. Geography. Ecology", 46, 136-145. Available at: https://doi.org/10.26565/2410-7360-2017-46-19 [in Ukrainian]*

31. *Sehida, K.Yu. (2017). Suspilno-geografichna kontseptsiya geodemografichnoi systemy regionu. [Social geographic concept of the regional geodemographic system]. Doctor's thesis. Kyiv, KNU. Available at: http://scc.univ.kiev.ua/upload/iblock/87b/dis_Sehida%20K.Y._new.pdf [in Ukrainian]*

32. *Niemets, L., Mezentsev, K. (2019). Sotsialna heohrafiia [Social geography]. Kyiv, 304 [in Ukrainian]*

33. *Telebienieva Ye. Yu. (2015). Suspilno-heohrafichne doslidzhennia sotsialno-ekonomichnoho rozvytku rehionu (na prykladi Kharkivskoi oblasti) [Socio-geographic research of the socio-economic development of the region (case study of Kharkiv region)]. PhD's thesis. Karazin Kharkiv National University, Available at: http://soc-econom-region.univer.kharkov.ua/wp-content/uploads/2017/07/Disertatsiyna_robota_Telebyenyevoyi_Ye_Yu.pdf [in Ukrainian]*

34. *Topchiiev, O. H. (2005). Suspilno-heohrafichni doslidzhennia: metodolohiia, metody, metodyka [Human-geographic research: methodology, methods, methodology] 632 [in Ukrainian]*

35. *Shablii, O. I. (2012). Osnovy suspilnoi heohrafii [Basics of human geography] Lviv Ivan Franko National University. 296 [in Ukrainian]*

Методологія суспільно-географічних досліджень: сучасні підходи та методи

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У статті розкрито роль суспільної географії у складних сучасних умовах розвитку світової системи та визначено авангардну роль методології в еволюції суспільно-географічної науки. Підкреслено, що суспільна географія як динамічна сучасна гілка класичної географії, сьогодні є потужною міждисциплінарною наукою, характеризуються розвиненою різноманітною системою методів, підходів, локальних теорії та концепцій. Проведено аналіз новітньої методології світової та вітчизняної суспільної географії. Встановлено, що сучасна суспільно-географічна методологія виступає об'єктом світового наукового дискурсу, проте здебільшого у аспекті розв'язання прикладних питань різного роду досліджень. Сучасні суспільно-географічні дослідницькі тенденції значною мірою відповідають на соціальний запит та виклики сучасності; дослідження спрямовані на вирішення актуальних проблем суспільства та навколишнього середовища зокрема, просторовий аналіз, моделювання і прогнозування, моніторинг соціально-економічного розвитку територій різного ієрархічного рівня; урбаністичні, економічні, соціальні, міграційні, демографічні системи і процеси та їхні регіональні моделі тощо. Представлено методологічні основи суспільно-географічних досліджень, розкрито сучасні підходи та обґрунтовано особливості методів дослідження траєкторії розвитку суспільно-географічних об'єктів, багатовимірного просторового аналізу та багатовимірної класифікації, розроблені та апробовані науковцями кафедри соціально-економічної географії і регіонознавства Харківського національного університету імені В. Н. Каразіна, наведені прикладі їхнього застосування. Обґрунтовано особливості суспільно-географічного підходу, що включає елементи системного, синергетичного, інформаційного, історичного тощо. Розкрито концепцію суспільно-географічного процесу в багатовимірному ознаковому просторі, що виступає основою суспільно-географічних досліджень та вміщує спеціальні (авторські, оригінальні), методи. Розкрито оригінальні методи просторового аналізу суспільно-географічного процесу, зокрема дослідження просторової взаємодії суспільно-географічних об'єктів (ІФВ-моделювання); дослідження соціогеосистем у нормованому багатовимірному просторі (моделювання траєкторії розвитку суспільно-географічних об'єктів та багатовимірна класифікація і діагностика системного розвитку), представлено можливості застосування наведених методів, які засвідчують верифікованість отриманих результатів.

Ключові слова: методологія, суспільна географія, оригінальні методи дослідження, просторовий аналіз, багатовимірний аналіз, інтегральна функція впливу, траєкторія розвитку, компонентний аналіз.