DIGITAL SURFACES IN SOCIAL GEOGRAPHY

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DIGITÁLIS FELÜLETEK A TÁRSADALOMFÖLDRAJZBAN

Összefoglalás

A számítógépes alkalmazások felértékelődésével és egyre szélesebb körű elterjedésével a területi kutatásokban is lehetővé vált a korábban hosszas számításokat igénylő eljárások gyors kivitelezése. Ez a lehetőség a kutatások új irányait vonta maga után, s ezzel együtt merőben új eredmények is születtek. Számos olyan területi-társadalmi vizsgálati módszer létezik, amely éppen a számítógépes alkalmazások révén jutott elismertséghez a geográfián belül is.

A társadalomföldrajzi felületek, valamint a társadalmi jelenségek területi képét felvázoló két- vagy háromdimenziós kartográfiai jellegű, leegyszerűsítő modellek látványosan mutathatják be a társadalmi jelenségek térbeli viszonyait. E módszer – és ennek számos módozata – eredményeit, végtermékeit tekintve újabb hasznos eszközként értelmezhető a területi kutatói eszköztárban. Bár a felületgenerálás a természet- és környezetföldrajzi kutatásoknak már hosszabb ideje kedvelt és elfogadott módszere, a társadalomföldrajzi vonatkozásai még csak most látszódnak kiformálódni.

Ez a tanulmány a különféle felületképző eljárások bemutatásán túl főképpen arra törekszik, hogy a földrajzi elemzésekben való alkalmazási lehetőségeket fogalmazza meg. Felhasználható például a társadalomföldrajzi felület módszer a szigetszerű, a trendszerű vagy a dinamikusan változó társadalmi jelenségek területi vizsgálatában, különösen segítve a vizuális interpretáció lehetőségeit. Különösen izgalmas eredményeket kaphatunk továbbá ezen eljárás más módszerekkel történő kombinálása révén is.

Summary

By the appreciation and the wider dispersion of computerized applications the implementation of procedures with formerly long lasting calculations became available also in spatial research. This opportunity brought new directions of research along with completely new scientific results. There exist a lot of methods in spatial-social examinations, which got acknowledgement in geography just by means of computerized applications.

Surfaces in social geography, together with the simplifying 2D or 3D cartographic models of sketching out the spatial pattern of social phenomena may spectacularly represent the spatial relations of social features. This method – and its numerous variants – regarding its results and outputs can be interpreted as another useful tool in the toolset of regional research. Although surface-generation is a favoured and accepted method of physical and environmental geography already for long, its connections to social geography are forming only just now.

This paper beyond the interpretation of different methods of surface creation primarily aims at formulating the prospects of application in geographical analyses. The methods of socio-geographic surfaces can be used for example in spatial examinations of island-like, trend-like or dynamically changing social phenomena, by aiding exceptionally the possibility of visual interpretation. Especially exciting results can be achieved by combining this method with other types of processes.

Fundamentals of making digital surfaces

At the dawn of the 21st century the forging ahead of the information society as well as the infiltration of its influences into different segments of ordinary life presented itself as an obvious and incontestable tendency. Nor the profession of regional research is an exception. Recently already in many cases it seems to be unimaginable to carry out new proceeding, theories and examinations without computer techniques. From the easiest to the most complicated tasks the computer is almost present everywhere in the process of examination. Computers, however, made easier and faster not only the long used and formerly evolved processes of examination. A great – and almost evident – advance is that it gave space for other, previously unknown and completely new proceedings and methods as well, and led to the evolution of new directions. Digital cartography, GIS and the discipline of geoinformatics, namely the analyses of geographical problems with means of informatics became new and even wider diffused methods for geographers and regional researchers. At the turn of the millennium as a result of the accelerated development of informatics a faster paced alteration can be seen also in computer aided geographical examinations. This all means that also in the computerised methods of examinations – as well as in instruments of informatics – an evolutionary tendency is to be seen, which develops new and newer methodological prospects from itself. As an outcome the revaluated digital trends have resulted that the making of digital surfaces piqued the interest of researchers also in social sciences and social geography.

Techniques of surface generation generally make it possible to explain the cartographic or visual results of spatial phenomena or a simply spatially measured process in 3 dimensions. Regarding its basic character this method is rather a means of visualization, beyond that it is able to announce further information about the examined feature. It can be considered both as an interpretation tool and as a method of examination (especially in socio-geographic analyses).

Researchers of social geography attached the duality – namely the parallel possibility of visualization and analysis – of this method with great artifice to their own way of thinking and problem solutions. Being learned and edified from the prospects of applying surface models in physical geography after adapting the previously evolved methods social science only had to formulate the new question of examination, which makes this method proper to research not only natural but social problems too. The openness of researchers and research methods of social spatial characteristics – that is typical anyway at the end of the 20th century and at the beginning of the 21st century – can already be seen towards other disciplines as well (see methods of physical analogies, NEMES NAGY, 1998). In this case the easiest way was to change data of physical nature to social data, while the only challenge was the interpretation of results. Naturally it was not enough to do simply this transformation, the method had to find its place among the set of different analytical means, practically, however, the social geography got acquainted with other prospects of surface application, and faced the needs of this method earlier, then after this was developed the prospects and conditions of applications in social geography.

Before introducing the ways of socio-geographic applications the concept of this method should be shortly reviewed. Either from a perspective of physical or social geography the starting position of making digital surfaces is the same. By picturing any phenomena on a surface the data of describing spatial position of the observed points (x and y coordinates) and the measured volume of the applied indicator at the observed points (z value) are applied to place the empirical values in a 3-axised coordinate system. In a simple coordinate system the results would compose disperse points or a point cloud, here though a surface is needed. If we consider each observed point being a point of the surface to be made, then the points of the „transitional" area among the points can be determined by interpretation

or other methods of estimation. Anyway these methods of interpolation and estimation mean the essence and the soul of the surface creating process. Since examinations like these need great amount of calculations, it was conformable that only the diffusion of computerization brought real and broad opportunity to create such surfaces.

Proceedings of surface creation and estimation can be various. The triangulated irregular network (TIN) model or the raster-like (GRID) model can be mentioned among others, or the estimation methods of polynomial regression or interpretation (for details see e.g. KATONA, 2003). Different ways of calculations give more or less differing results and need different interpretations of outputs.

The evaluation and interpretation of surfaces made by various methods and digital processes in social geography show remarkable difference compared with those in physical geography, although the previous phases of surface generation were methodologically analogous. The interpretation of digital surfaces in social geography can hardly be so „automatic" than sometimes in physical or environmental geography (stating that proper analysis and interpretation of surfaces in physical geography need also practical knowledge).

At the interpretation of surfaces in social geography it must be always kept in mind that social processes are not contiguous in space. The discrete observed data (on any spatial level) do not give unambiguously the opportunity to carry out any kind of interpolation implicitly. In the research of social geography at the interpretation of surface outcomes therefore it should be clarified whether a point outside the observed ones contains real or true information. Essentially even this sets a limit to use surface models in social geography. Surfaces of social geography therefore can be evaluated only very rarely „on their complete reality", the correct method of appreciation is rather the evaluation of general tendencies, trends and spatial characteristics of the results. Namely it can not be affirmed on an observed point of the surface that the empirical „z" value surely indicates the value of the social indicator at the connecting geographical point. This method nevertheless aims at making a model as similar to real (physical) surface as possible. It is important therefore to note this basic difference between the interpretation of physical and social surface models.

Prospects of application and interpretation in social geography

Advantages and disadvantages can be formulated as well about why it is purposeful sometimes to apply (also) digital surfaces during spatial research of society. It is obvious that the processes of interpretation – due to the formerly mentioned reasons – are not always unambiguous and sometimes the implementation of this method may frighten off someone. On the other hand some of the researchers see also new opportunities in the application of this method.

Basically this method may come into the forefront after placing an appropriate problem or question. If the aim of the examination were the visualization of spatial differences and regional trends of the society, beside a classical thematic map this method could also help in better understanding the results of examination. Therefore, at the application of digital surfaces in social geography, firstly the research question should be formulated, after that the problem solution may come (in this case the creation and visualization of the model) that would be closed by the analysis and evaluation of the created surface.

One or probably the best-known benefit of this model for researchers of social geography is the possibility of complementing previous research information. A significant part of researchers use these types of models for supporting results that were calculated differently (e.g. GRASLAND – MADELIN, 2001). It is though also unquestionable that several examination results can be visualised also on a simple thematic map, while this new type of map is not more than another sort of repeating information.

Relevant or probably the most important advantage of surfaces in social geography is the opportunity of getting new or novel information. By means of this method new connections can be discovered in the background of the formerly accustomed scientific statements. Placing an everyday thematic map – word for word – into another dimension can put certain knowledge into new light.

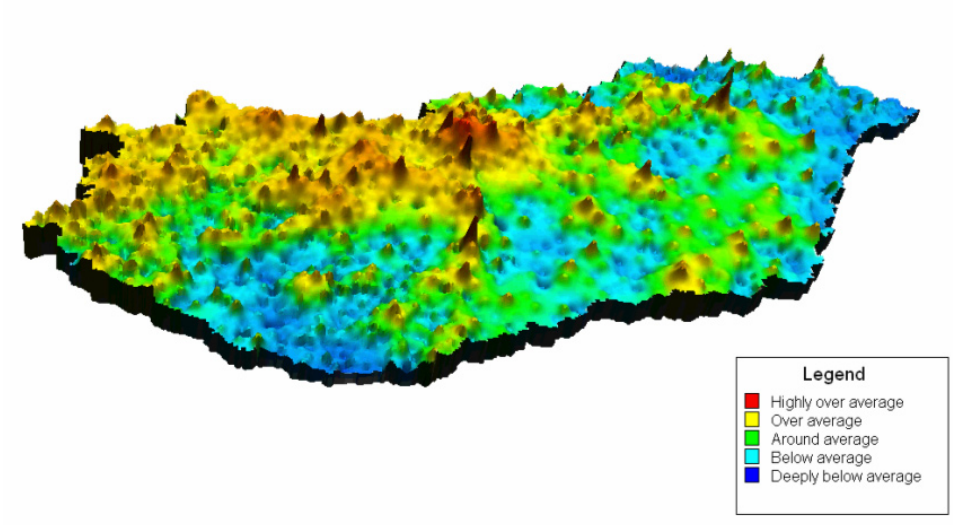

Figure 1. Surface of per capita income measured on settlement data in Hungary (2001)

In *Figure 1* the surface map of per capita income of Hungary can be seen, which was calculated on settlement data. In this figure, where data are presented on a perspective surface, data of selected settlements can be read much harder than in a typical classified thematic map, since – due to the lack of settlement borders – the position of each settlement can be determined only with great practice. At the same time this was not the aim of drawing the surface model. In contrast with thematic maps in the case of surfaces it is rather possible to clarify neighbourhood relations, basic spatial tendencies or regionally extraneous features. The scenery accustomed at figures of physical geography is presenting itself here in social relation with emergences and depressions in social space.

Taking over the way of approach of physical geography social surface maps can introduce or confirm new phrases in socio-geographic research. The description of social phenomena with physical geographical analogies can place some long-standing elements of examinations into a new light. In social context the phrases of „hill", „valley", „trench", „table", „island", „depression" or „basin" are meaning completely new things.

Looking at the digital surface of the income dispersion the above-mentioned phrases of physical geography can be unambiguously identified. From the average level of the surface of incomes in Hungary some major industrial cities are exceeding out as islands (Paks, Tiszaújváros), or it can be formulated that some hills are rising over the relief (Szeged, Szolnok) that are showing remarkable difference in elevation compared to their neighbourhood. In this case the unit of elevation is not meter rather than the volume of income measures in Hungarian forints.

This type of describing social phenomena makes the previously abstract spatial structure much more realistic beside the symbolic composition. Nevertheless it should be emphasised that an approach like the above mentioned one could be complete of value

rather with other methods together. It is useful and purposeful to create surface models when the analysis is focusing on typically island-like social phenomena (see segregation studies) or at examinations of locally strange or out of place situations (see residual analyses) as well as at the studies of main spatial trends and tendencies (see regression analyses).

In the cases of surface models of social phenomena the prospects of analyses are the same as in the cases of traditional surface models. A cross-section figure can be made for example (see *Figure 2*), in which the settlements that are differing from average the most are spectacularly appearing, and which already foreshadow the west-eastern slope (especially east of the capital) that could be seen more clearly on an other type of surface model, namely on trend surfaces.

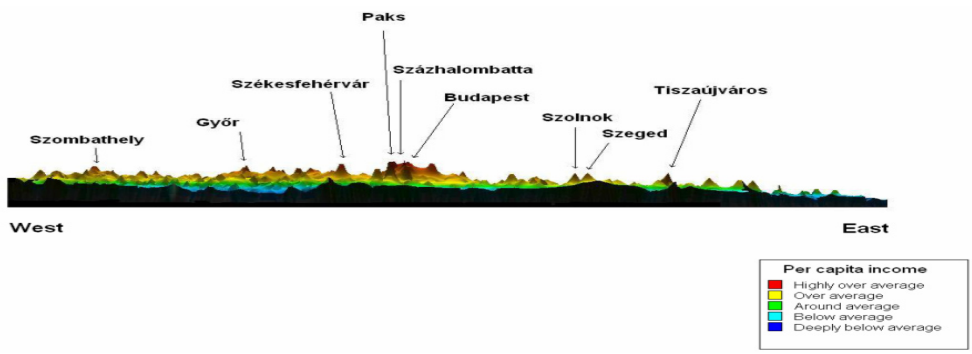

Figure 2. West-Eastern cross-section of the surface of per capita income measured on settlement data in Hungary (2001)

The so-called trend surface analysis (see *Figure 3*) is a long-standing method of surface creation, which was also recognised by researchers of social geography. This method can be defined as a subtype of social surfaces, while others state that it is a different and completely new method. During examinations of social phenomena with trend surfaces the trend-like elements of the observed component are stressed and analysed. The process uses the traditional method of multivariable regression, namely on a selected location with concrete (x; y) coordinates gives the expected „z" value as result that springs from the geographical position of the selected point. Since this procedure is looking for the best fitting surface of the point set of the observed values, it is frequently experienced that the locally estimated value differs from the originally observed data. Talking about regression it is not surprising to have such deviations. The spatial structure of social features can not be precisely described with one regression surface, therefore the aim can not be else than the determination of the best averaging surface. After all the basic problem of the research is to describe and estimate the complicated spatial processes of the society by the simplest forms.

The trend surface of unemployment in Hungary (*Figure 3*) shows rather east-western slope just opposite of the previously mentioned west-eastern gradient of incomes (*Figure 2*). The slope that was drawn on the ground of the estimated unemployment data of the settlements leans from high eastern values towards lower values of the west (with a small southeast-northwest component). After all one of the aims of this figure can be the verification of the macro-level tendency of a social feature, namely the unemployment.

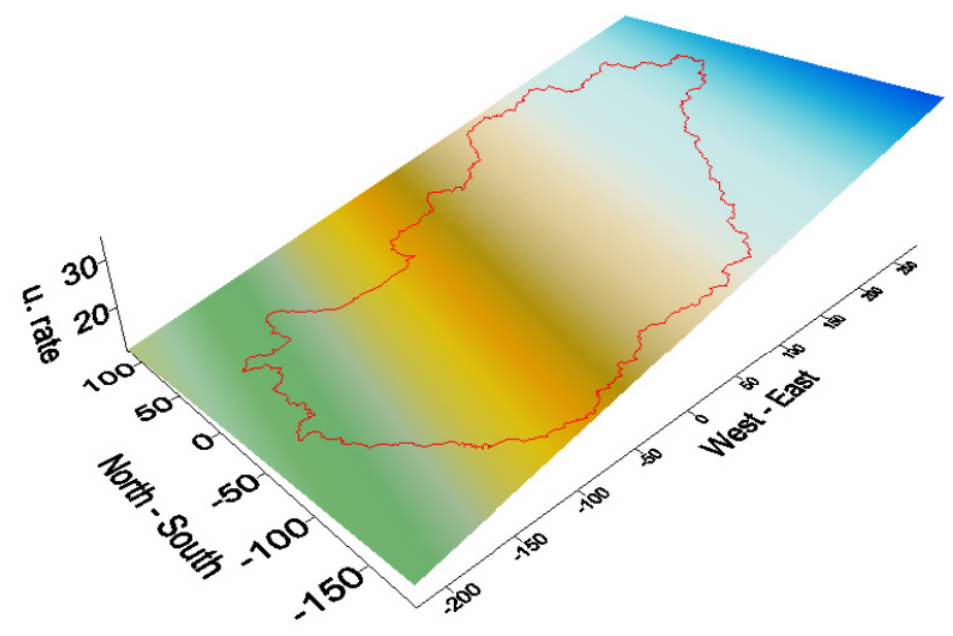

Figure 3. Trend surface of unemployment rates in Hungary (2001)

The application of social surfaces in different contexts

The ways of possible application of digital surfaces in social geography can be much broader than the ones mentioned above. Eventually only the inventiveness of researchers set limit to the application by reserving the opinion that the applied method always should be professionally unquestionable.

Spectacular results can be achieved already when the above-mentioned processes are applied in a dynamic form. By creating socio-geographic surfaces about a region in different segments of time, it is possible to follow the alteration of the spatial structure of the examined social factor. This method can be well used for example in diffusion analyses.

Further application variants are those that visualize the results of other analytical methods on a surface model. Such a technique was applied by Claude Grasland and Malika Madelin (2001), who illustrated the GNP data measured by spatial moving average on a surface model (see *Figure 4*). They measured the average value of GNP in a circle with a radius of 1000 km, making a picture appropriate for drawing great and global level statements.

Since in the 21st century the flow of goods and persons moved on a much more unengaged way through international borders, new analytical means were needed to determine which regions attract income the most. That is why a borderless map of the world was used that approximates the above-sketched situation well. The best „approachable" points of the surface of wellness do not fall in line with focus regions of population (e.g. India or China). An American, a European and a Japanese city (region) are the ones closest to the largest income concentrations. This figure well reflects the classical duality of North and South.

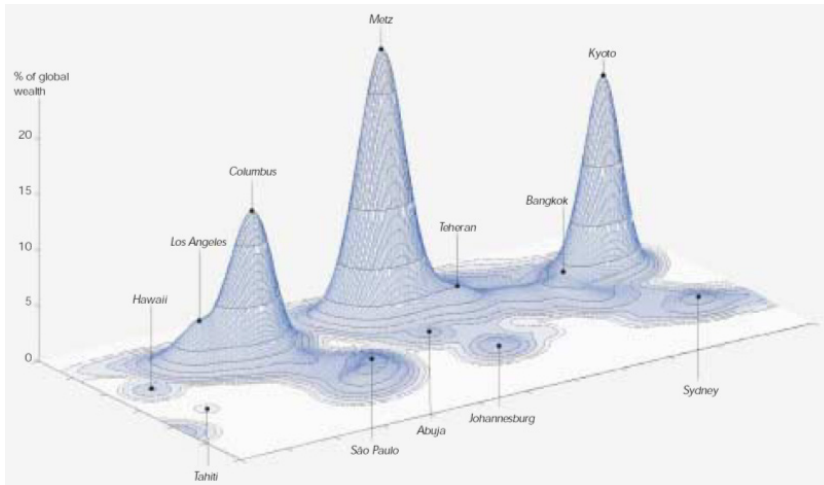

Figure 4. Surface of wellness (GNP) in the world measured by moving average in 1995 (Source: GRASLAND – MADELIN, 2001)

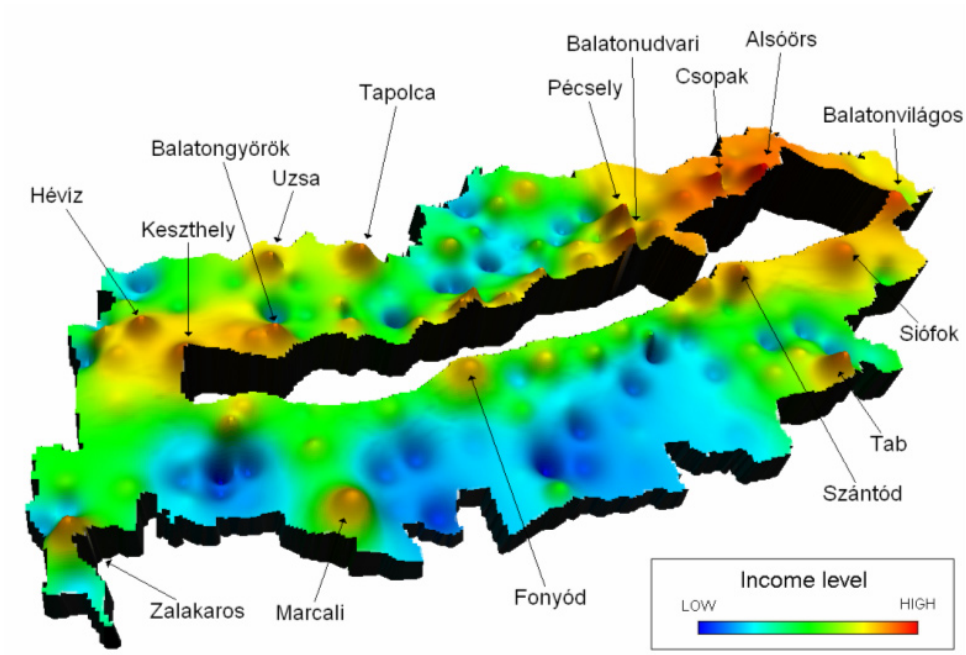

Figure 5. Surface of per capita income measured on settlement data in the Balaton Region (2003)

Also images of smaller regions can be delineated on surface models. The model representing the Balaton Region in Hungary graphically shows the position of the richest and poorest settlements (see *Figure 5*). The relative better position of the northeastern region can be seen obviously. The coastal areas of the eastern gulf of the lake emerge as „mountains" over the surface. It is conspicuous that cities exceed from their neighbourhood

as islands in this picture. The contrast is particularly sharp in the case of Marcali and its surroundings, and at the town of Tab and its neighbourhood, furthermore also other town could be easily found in the image. The settlements that are appearing with forms like depressions are the ones that produced values lagging behind the regional income average the most. More or less continuous „deep" parts can be discovered on these areas, while „depressions" come forward only dispersed on the north coast. These results confirm the outcomes of former research on the whole from an other perspective: settlements of the southern region with larger distance from the coast are in the worst position.

Summary

Despite being known mainly as means of physical and environmental examinations the method of surface creation found opportunities also in research topics of social problems, where this method can be successfully utilised. By the usage of digital surfaces of social geography not really the creation of surface means a problem, as by some other processes, but rather the interpretation of the out coming results and the presented picture of the surface. In connection with this method it should be primarily emphasised that mainly the scientific and professional content can set limits to application, namely surface model can be made almost on every data, however the created figure is not always meaningful.

It can be definitely mentioned as an advantage that the previously perhaps abstract spatial characteristics and differences of society are appearing quasi tangibly within this method. Hence it can be used not just as a tool of visual interpretation, but also as reference work or application in education, where the picturesque presentation might be an obvious aim (e.g. at illustrating the cumulated value of emission on a surface). Above all the range of applying this method is nearly unlimited: it can be used for example in contexts of transportation geography, at accessibility calculations or at examinations of concentration or segregation.

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