GEOSPATIAL CRISIS INDEX – USE OF MASS DATA IN SECURITY GEOGRAPHIC ANALYSES IN THE HUNGARIAN DEFENCE FORCES IN THE FUTURE

Péter Balog, MSc

Doctoral School of Military Sciences
University of Public Service
Hungary

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ABSTRACT

Security geography examines the military geographical factors that influence the security system and environment of an area, its method of investigation is rooted in geography. The analysis is based on the collection of information from open sources. The related databases to this are a rapidly changing data set, so its analysis shows only a current state, but if the data set is large enough, it is considered mass data, which may be suitable for drawing new correlations and conclusions for the future. The geoinformation analysis system under development applicable to the security geographical analysis continuously collects data for a limited area of interest, considering predefined variables. The collection of data is basically done based on algorithms, from continuously produced data from diverse sources and forms. The above-mentioned results can be obtained by continuous and rapid comprehensive analysis of these datasets. The results can be used in the decision-making process, and supplemented with human analysis.

INTRODUCTION

At the beginning of my article, I would like to clarify what I mean by the security geography support of the Hungarian Defence Forces, later I will examine how mass data can be used for this, in the present and in the future. I will examine the information that can be obtained from open sources, its role in geoinformation support, the types used, and method of application. Finally, I present the geospatial analysis system under development and the related geospatial crisis index.

The leading and managing body of military geospatial support in Hungary is the Geoinformation Service of the Hungarian Defence Forces (HDF). I am the Head of Military Geography and Training Department of this organisation. At the same time, I am a student at the Doctoral School of Military Sciences of the National Public Service University, where my research topic is the possibility of developing geospatial evaluation and analysis systems for the security and defence geography analysis of Crisis Zones in the Area of Interests of the Hungarian Defence Forces.

The aim of the geospatial support is to provide the organisations of the Hungarian Defence Forces with all the geospatial materials, information, and data essential for their activities, to provide the geospatial data of the areas necessary for the execution of the given tasks both during peace tasks and during crisis response or war operations, thereby contributing to the geospatial support of the activities of the allies.

This activity includes the production and acquisition of cartographic and military geography materials and data, as well as meteorological information, their timely delivery to HDF and NATO organisations, and preparation for the use of materials and information. Being landlocked, Hungary does not collect oceanographic data, therefore, „GEOMETOC" (Geospatial, Meteorological and Oceanographic) data is limited to „GEOMET" in the country.

I have examined the following hypotheses during my doctoral research so far.

- Can military geographic factors and their methodology be used for security geography analysis as part of a geospatial analysis system?

- Does the mass data available provide the quantity of spatial data suitable for such a geospatial analysis system?
- How should we plan the geospatial analysis to support military personnel?
- How can we delaminate the area to be analysed?

1. SECURITY GEOGRAPHY

Security is the absence of a threat (Gazdag and Remek, 2018, p. 17). Security geography examines the totality of military geographic factors that affect the security system and environment of a given area (Siposné Kecskeméthy, 2019a). Military geographic analysis uses a basically territorial, military, and strategic division in its analysis at tactical, operational, and strategic levels. Although there are Regional Security Complexes based on geographical proximity in the context of security geography analysis, which Buzan and Wæver say is a group of states whose security-related problems are closely interlinked, the spectrum of security threats is examined in a complex way, security complexes are being developed (Buzan and Wæver, 2003, p. 44).

Marton introduces the concept of a question-specific security complex, where security complexes are based not on territorial but on causal events (Marton, 2019). According to him, spatiality cannot be drawn for all security complexes, although it does not call the role of geography or maps into question, their role in depicting certain geographical sources, pathways and mechanisms still remains. He says the definition of a threat within a security complex can be geographically or causally debatable, and can exist from multiple legitimate perspectives (Marton, 2019, p. 121). It does not deny the geographically based relationship, it just doesn't satisfy it. This idea is also based on the opinion that certain elements of a threat form spatial boundaries with each other, so there is a geographically mappable spatial connection between them.

Both security geography and military geography are rooted in geography, so it can be stated that security geography analysis includes military geographic factors, such as geographical location of countries, physical geography, socio-political conditions, economic, transport characteristics, military, national security information, history, ethnic and armed conflicts in the country (Siposné Kecskeméthy, 2019b), only the approach of the analysis is different. It is important to mention here that some of the threats, armed and, especially ethnic conflicts are not necessarily limited to a country, so sometimes for these analyses we need to use other kinds of delimitation than administrative boundaries. Military geography helps us to delimit the crisis area, and the Military Security Strategy (Hungarian Government, 2021) derived from the National

Security Strategy (Hungarian Government, 2021) helps us to identify threats. During the security geographic analysis and geospatial assessment, we perform the expert work that gives the result.

1.1. DIMENSIONS OF SECURITY GEOGRAPHY AND DATA

There are social, environmental, political, economic, military and IT dimensions of security, so these are examined and analysed by the respective sub-science of geography dealing with them (Gazdag and Remek, 2018, pp. 21–24). Nowadays, in the age of unlimited warfare, it is difficult to define where the battlefield ends and where the area that is no longer part of the battlefield begins. Geographically relevant, mainly natural areas (terrestrial, marine, aerial and cosmic), social spaces (military, political, economic, cultural and psychological) have become operational dimensions as well – forming more dimensions, so it is considered more like a battlespace than a battlefield. Respectively, the cyberspace connecting geo and social spaces has all become an operational dimension (Szenes, 2017, p. 90). Attacks that threaten security can no longer be characterised simply by occupying or retaining territory.

The information and data used for security geographic analyses can all be linked to the Earth and its immediate surroundings, it refers to its immediate environment, in our current terms these are all geospatial data. There is no difference between the safety geography and the geospatial analysis in the location of the examined area, only in its size and delimitation, similarly there is no difference in the available data, only in the methodology of processing.

The Hungarian Defence Forces should use a geospatial-related dataset to ensure the security of Hungary in security geography matters derived from and in conformity with Hungary's National Security Strategy (Hungarian Government, 2020). See chapter 3.2 for details.

1.2. SECURITY GEOGRAPHY AND GEOSPATIAL INFORMATION

Geospatial information is "a set of spatial data and information about the Earth and its immediate surroundings" (Kállai, 2019a). All factors that have a geographically relevant security dimension or have an impact on geographical and social relations that may influence the outcome of a potential crisis, the possible course of armed conflict, must therefore be part of modern geospatial analyses. Different dimensions of security examine different sub-areas, yet together they affect the security of an area, so that a crisis area needs to be delineated and studied locally, regionally or globally, depending on the nature of the effect (Gerencsér, 2016, p. 21). This effect may vary, as mentioned above, social, environmental, political, economic, military and IT dimensions of security are differentiated.

We needed a large dataset to be collected for this study. All data from publications intended for wider use should be obtained from an open source to avoid classification. In addition to the use of printed sources, the Internet and open-source information gathering provided excellent opportunites.

2. OPEN-SOURCE RECONNAISSANCE

The Geoinformation Service HDF uses publicly available databases and resources, especially when preparing publications of the Military Geography and Training Department, all of this data is collected by the method of Open Source Intelligence (OSINT).

OSINT is an intelligence using open, non-secret (meaning freely accessible, usable and downloadable) public, accessible resources (Kovács, 2019). The point is that the data is publicly available to all individuals through legal means, possibly with limited dissemination, but not classified information. The exploration, collection, selection, analysis and evaluation of the use of this data for professional purposes is covered by open-source reconnaissance. There are several advantages and disadvantages to this.

The advantage of OSINT is that, besides such information, especially spatial data, has never been available before (Olasz, 2017, p. 12), a large amount of information can be obtained in a relatively cost-effective way (Dobák 2019 p. 87). Of course, it is not enough to collect this data, the information must be filtered, selected, organised, analysed and evaluated, always according to the defined purpose. This can be a disadvantage as it slows down the process, requires professional qualifications and experience, along with continuous training and organisation. Likewise, too much information can be a disadvantage if not handled properly. The need to know everything about everyone may be an expectation, but it is unachievable. As Karcsai (2021) demonstrates the problem "It is like a pizza: basic information, as topographic background (pizza dough) and technical data (tomato sauce) are musts, but all other information (just as all kind of toppings) cannot or can hardly be placed on a map (the pizza dough)." However, it is a rational need to collect all this information and, after a suitable professional selection, analyse and display it to the required extent.

There are three types of open source data that shall be clearly distinguished, They are (1) open source data, which means a raw document or knowledge that can be provided by primary sources like a photograph etc., (2) open source information, which means data processed, collected, selected, and evaluated according to a given approach, and

(3) open source information acquisition, which is the procedure itself, when information is obtained from openly available sources, in order to achieve a specific goal. During the activities carried out at the Military Geography and Training Department of the Geoinformation Service HDF, the given approach is to strive for the implementation of geoinformation support, to ensure the objective, relevant, current – in space and time – and accurate preparation of military geography materials and publications. This means simultaneously supporting the preparation of text publications and the construction and maintenance of geospatial databases.

It is necessary to prioritise, to be able to determine which of the available data should and can be used for the given task - which is relevant. To filter out what we know, and what may be useful to us later, but we don't take into consideration now. This also requires experience and qualifications, but the development of competent professional skills (IT solutions, experts, analysts) requires additional resources. In addition, we can – and we have to – sort through the data. Multiple matching data can be confirmed if multiple independent sources contain the same information, it can make the data more authentic, but care must be taken because redundant storage can tie up excess capacity. The availability of metadata, secondary information assigned during processing, is potentially essential in this regard, potentially for anything we consider important to associate it with, it also provides data retrieval.

If we follow the above concepts, we will carry out the process of searching for, collecting, selecting, evaluating and using data within the activities of OSINT. It is worth mentioning that we do this from open sources so that publications made from them are not classified and available to the target audience. The importance of OSINT connected to cyberspace is becoming more and more decisive, and the ability to analyse mass data files also provides an extraordinary opportunity for the Hungarian Defence Forces. At the same time, the time factor has become one of the most important elements of OSINT, which is an indispensable factor for quick decision-making in addition to credibility and control (Dobák, 2019, p. 87). Of course, OSINT does not replace the collection of secret information, but it complements and orients it, and may even replace it in the preparation of geospatial-related publications, depending on the target task.

3. TERRITORIALISATION OF DATA AND EVER-CHANGING GEOGRAPHICAL SPACE

The interpretation of space is constantly changing, becoming multidimensional, in English terminology the term "battlespace" is used much more than "battlefield". The military science approach and definition of space is also changing. Anything that has a spatial or geographical relevance can be interpreted as space. Geography is an unavoidable factor for warring parties. The mode of warfare, the forms and methods of application of the armed forces, depend crucially on the factors influencing its implementation (Szendy, 2017, p. 106). These factors are realised in space, so in all five dimensions of the new battlefield concept – land, air, sea, cosmic, information (Szenes, 2017, p. 97). Time also has an increasing role: the significance of having immediate access to real-time information has become more vital than ever. We need information about everything, and we need it now. It influences the warring parties, shapes the weapons used, and increasingly resolves conflicts. The analysis of the characteristics, determining the essential properties, components and relations of the space, and the analysis of the data collected by the methods of the examination of military geography is the task of the geospatial evaluation (Kállai, 2019b). After data collection, the totality of military geographic factors is examined by security geography, which determines the security system of a given area and its surroundings (Siposné Kecskeméthy, 2019a) both horizontally and vertically.

3.1. OPERATIONAL SPACE

"However, a network-centric military operation is not a substitute for the professional (military) knowledge and preparedness of commanders and soldiers. In other words, we can only pass on so much information to decision-makers that they have an accurate understanding of the situation, not more" (Szternák, 2008). The space known in this way is the operational space, which, contrary to the "traditional" battle areas has no dimensionally, but rather, technical limits. Thus, the operational space is the cognitive space of the geographical space that has been specially learned and processed by decision-makers and executives for a given level of operation and activity. This operational space and military

activity interact, shaping each other dynamically, as the operational space is the one where planned and ongoing military activities take effect. Geospatial information analysis is a tool for cognition and processing of it. In the context of the security space of Hungary, operational space should be understood as any potential armed conflict areas, most importantly in the area of Hungary itself and in the bordering countries in order to assist that the safety of Hungary, even in the worst-case scenario, could be guaranteed."

Hungary published a new National Security Strategy in April 2020 and a new National Military Strategy in June 2021. According to this mass migration is a key issue in Hungary. The armed forces participate in international crisis-management missions, most importantly in the Balkans and Iraq, approximately 1200 Hungarian officers are deployed on international missions. (The Military Balance, 2022). Moreover, Hungary is sending officers to the Sahel region and the Iraqi mission of the national defence has also been extended. In the second half of 2022, the Hungarian Defence Forces will also perform the airspace policing tasks of the Baltic states. In addition, Hungarian soldiers serve in Kosovo, in the NATO-led KFOR peacekeeping force, in Bosnia-Herzegovina, in Cyprus, in the UN mission, officers perform observation tasks in Georgia and Western Sahara, perform training and preparation tasks in Mali, and Hungarian soldiers are present in Kuwait and also in Lebanon. These mission areas are also regarded as possible targets of geospatial-related crises analyses.

4. ROLE OF MASS DATA IN GEOSPATIAL INFORMATION ANALYSES

Gartner is a global research and consulting firm that provides information, advice, and tools in areas such as IT and communications. According to them Big Data – in this article I regard mass data the same in volume and nature – is high-volume, high-velocity and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision-making, and process automation (Gartner Glossary, 2021). This means capturing, processing, analysing, sharing, and visualising unprecedented amounts of mass data from a variety of sources.

The amount of data available exceeds the capabilities of commonly used data capture and processing software. According to the most common definition, this kind of spatial mass data is characterised by three things: quantity, speed, and variety (Laney, 2012). It means that a huge amount of data is available that is generated continuously and quickly, and all of this is usually unstructured (Szűts and Jinil, 2016, p. 11).

4.1. SPATIAL MASS DATA

Studying the geospatial analysis system under development is part of my doctoral research. Analyses discussed in this article are derived from the results originating from the system as well as the developments made to it. All geo-related spatial data and specific sources for data collection had to be accurately determined before the developing process, through the system plan. The database should be large enough to draw appropriate conclusions, however, an agreement on the definition of the term "large" has not yet been reached. Potentially the whole internet is a dataset, and the developed system should analyse it regarding the respective crisis phenomena.

Spatial data in the traditional sense, such as vector and raster data, have also undergone tremendous development, encouraged by the development of data collection software. Data collection time has been shortened and the amount of data surveyed at one time is increasing, largely due

to new generation technologies, such as the Unmanned Aerial Vehicle (UAV) used for remote sensing, aerial surveying or orthophoto, the Remotely Piloted Aircraft (RPA) and laser-based remote sensing, LiDAR (Light Detection and Ranging) (Olasz, 2017, p. 12). Analyses show that the amount of newly or repeatedly generated digital data reaches 44 zettabytes (1 zettabyte = 44×10^{21} byte). However, only about a third of the data set created in this way is suitable or worthy of analysis, so most of the data we create, and store is not useful in this sense (Gantz and Reinsel, 2012).

As the available data increases, the processability of the data does not keep pace. The rate at which supercomputers are being built cannot keep up with user demand. The analysis of the data after the data collection and the publication of the knowledge is not fast enough compared to the amount of data received, therefore pre-processing, data preparation, coordination of data and information from different sources and, if necessary, targeted data collection plays a particularly important role.

One of the key elements in processing, in addition to relevance, is speed. Spatial mass data is always linked to a well-defined geographical location, furthermore, it can be originated from very different sources and in very different formats. This data needs to be cleaned, filtered, analysed and published in a very short time as expected (Olasz, 2018, p. 33). In spatial mass data technology, reliability, connectivity, value, and display characteristics are paramount when analysing spatial data (Olasz, 2018, p. 34). Collecting and characterising spatial data alone is not enough, Shekhar said in a 2012 presentation that "location-aware datasets are of a size, variety, and update rate that exceeds the capability of spatial computing technologies" (Shekhar et al, 2012).

All data, especially the data used for urgent security geographic analysis, should be available almost immediately and should cover as accurately as possible the area and security factor we intend to analyse. Thus, we have reached the limit of the processing capacity in the possibility of quantitative data collection, it does not make sense to collect more data, or increase the processing volume, the pre-selection and the targeted data collection needs to be developed (Lee and Kang, 2015, p. 78). The geoinformation analysis and evaluation system that we are developing during my doctoral research uses the latter method.

Big Data – in this case mass data – is a huge data set that is created when using networked devices that change rapidly, so its analysis shows only a momentary state. If the data set is large enough, it may be suitable for a level of knowledge of a given process that can be used to formulate relationships that have not been explored with good efficiency or to draw conclusions for the future (Szűts and Jinil, 2016, p. 9).

The system to be developed continuously collects data for the delimited, given area of interest, considering the variables we have defined. The delimitation of the area can be done on an administrative basis – by designating country borders, regions, groups of countries – or by defining the specific security complexes in the case of cross-border natural and social phenomena, natural and/or social disasters, such as flooding or locust infestation and, as a most likely consequence of it, migration.

The data collection is basically based on algorithms, which were further supported by the spread of IoT (Internet of Things) tools and the resulting larger amount of data. The available database is often not a single database, but a set of data that is continuously produced from a variety of sources and formats, with the continuous, fast comprehensive analysis of which results can be obtained (Szűts and Jinil, 2016, p. 11).

4.2. RISK FACTORS TO BE EXAMINED

What could be the risk factors to be examined? According to Hungary's National Security Strategy (Hungarian Government, 2020), the key security risks which may affect Hungary, closely related to security geography, are the following:

- illegal migration
- unexpected armed attack
- financial and economic destabilisation of Hungary through diplomatic, information and intelligence operations
- cyber-attacks

- an act of terrorism in Hungary or against Hungarian interests abroad
- attempts to infringe on national sovereignty by depriving national decision-making powers
- sustained population decline, ageing population
- international economic crisis
- disruption of energy imports
- the establishment of a "failed state" in the immediate vicinity of our country or in our region
- revolutionary technological developments falling into unauthorised hands
- strengthening the influence of criminal organisations
- an attack or terrorist act against Hungary or the surrounding countries with weapons of mass destruction (nuclear, radiological, biological, or chemical)
- industrial accidents in Hungary or neighbouring countries
- an epidemic causing mass illness
- the formation of higher floods and extensive inland waters
- permanent water shortages due to global warming.

All geospatial information (as a minimum set) related to the above-mentioned crisis possibilities should be studied by the Hungarian Defence Forces to enhance Hungarian security in the best possible manner.

It is, therefore, necessary to provide the most probable results derived from the huge mass of openly available data as soon as possible, so that the command decision-making process can been shortened. I call this

result the Geospatial Crisis Index. It helps to decide which area is necessary to be analysed in more detail, and needs geoinformation assessment with the involvement of human resources, even with the help of experts from other related disciplines. The system, however, will not replace a detailed, human-intensive evaluation analysis, but precede it. It helps with prioritisation, so work can be more focused and thus more efficient.

During the conversion of text-based mass data into textual geospatial evaluation, the data is transformed and can be stored in a traditional GIS database after format conversion, but is not interpreted on its own. The data must be provided with metadata for the geographical location, socio-geographical database (Olasz, 2017, p. 19). It reduces the size of the database, the types of data to be systematised, and if the area is properly delineated and the risk factor is properly defined, the algorithm collects data in a targeted manner. It is not the processing time that is shortened in the first place, but the time of data collection – of course, this shortens the whole process.

5. GEOSPATIAL CRISIS INDEX

As part of the geoinformation analysis system under development, a new index is being developed. The Geospatial Crisis Index is a unitless numerical value issued by the geospatial assessment and analysis system used for the geospatial analysis of crisis areas. It is created by an algorithm-based methodology based on open-source data related to military geographic factors. It provides a benchmark that allows areas to be compared for a fixed risk factor, or to organise the factors into a hierarchy by fixing the area. This helps to shape the order of the analysis, speeds up the actual textual and map evaluation, reduces the need for human resources, and supports commanders in decision-making. The methodology of the algorithm-based definition of the crisis index, based on military geographical factors, is under development as well.

The target group of users of the Geospatial Crisis Index is primarily the professional staff of the Hungarian Defence Forces dealing with geoinformation, including those whose tasks include geoinformation evaluation but, as a consequence of it, the entire defence staff can enjoy the benefits of this innovation. At the commander level, the expectation is a quick, clear, essential product, accordingly, where the Geospatial Crisis Index along with other specific information and data such as thematic maps are useful tools in evaluation and, based on them, decision making.

5.1. SYSTEM PLAN OF THE GEOSPATIAL ANALYSIS SYSTEM

The system plan of the geospatial analysis system under development is as follows.

Crawler/spider:

- Downloads information from web pages into a Local Database.
- Based on existing, downloaded web pages, it searches for "similar" web pages using machine learning algorithms.

Processing engine:

- Extracts important information for the system from downloaded web pages.
- NLP – Natural Language Processing. Preprocessing involves preparing original text data for software to be able to analyse it, and for an algorithm to work with.
- ElasticSearch – It is a search and analytics engine that can be used to search any kind of document. Acts as a stable environment during the process of storing large amounts of data and content. In addition, this technology enables data retrieval and storage extremely quickly.
- Data reliability investigation and testing new data.

Administration interface (UI):

- Here one can set the search parameters, such as:
    - search terms
    - value limits
    - events to watch
    - territorial distribution
    - etc.
- Manages the source data:
    - a new source that can be added manually (typically, for example, a new web address)
    - existing data that can be modified or deleted
    - new, raw data can be uploaded

    - ranks the sources (e.g., in terms of reliability).

Risk factor (Geospatial Crisis Index) calculation module:

- Weighs the processed data based on the parameters specified on the administration interface.
- Calculates the risk factor of the given area or event.

Display:

- Displays the parameters specified on the administration interface and the resulting risk factor in a way that is acceptable to users:
    - on a map
    - in a graph
    - external data requester, in a form that can be processed by a third party (ArcGIS).

The results of my research so far:

- The investigation method of security geography is rooted in geography, it examines the military geographic factors that influence the security system and environment of an area. Publications on it must be open materials to reach the target audience, so we use data from open sources to create them.
- After quality processing, i.e., selection, analysis, and evaluation of a sufficient amount of the available spatial data, a new opportunity will present itself for the preparation of security geography analyses based on geoinformation professional foundations.
- Algorithms can be applied to the momentary analysis of the ever-expanding, huge geo-information dataset regarded as mass data. This can be used in the commander's decision-making system, and prioritised before decision-making.

- The process is suitable for the analysis of the security geography risk of an area, even for hitherto undiscovered connections, or for formulating conclusions about the future.

The geoinformation analysis system usable for security geography analysis examined in my research continuously collects data for a delimited area of interest, depending on specified variables – geographical factors regarding the specified crisis phenomena. The data collection is basically based on algorithms, from a set of data that is continuously produced from diverse sources and forms, and the above results can be obtained through continuous, rapid comprehensive analysis.

CONCLUSIONS

The analysing method of security geography is rooted in geography, examining the military geographic factors that affect the security system and environment of a given area. This necessary territorial delimitation is the basis for the preparation of geospatial information analyses and evaluations examining the same factors. These publications must be open materials in order to reach the target audience, so we use open-source data to produce them. The risk factors to be considered in security geographic analyses can be created on the basis of the National Security Strategy, the delimitation of the operational space is the task of security geography specialists. After defining the area of interest and the crisis factor, we can perform the analysis and evaluation, and the Geospatial Crisis Index. The final concept of this, the finalised solution of the data processing algorithm and a working demo version of the whole geospatial analysis system is part of future research, and a topic for a future article.

The amount of spatial data available for this purpose today provides a new opportunity for quality processing – selection, analysis, evaluation – during the preparation of security geographic analyses based on geospatial information. Relying on the system created by the experts, the data for the given variables can be collected and used according to the purpose of the task. With regard to the ever-expanding, geospatial mass dataset, algorithms can be used for instantaneous analysis. This can be used in the command decision-making system to help prioritise. The process is suitable for analysing the geospatial security risk of an area, either to formulate unexplored correlations or to draw conclusions for the future.

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Contact:

Péter Balog, MSc
Doctoral School of Military Sciences
University of Public Service
Hungary
E-mail: balog.peter@mil.hu

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