Geo-information technologies to support management decisions in emergency situations

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Abstract. Management process of an emergency situation is characterized by the involvement of a large number of organizations and specialists in various fields and by using a wide range of information technology tools, which allow substantially automate the work to prevent disasters and consequences response. In an emergency, one of the key issues is the quality of geoinformational support of management decisions, timely creation and updating of electronic and digital maps. This paper describes the instrumental reference analytical geoinformation system, which allows for the professional GIS processing, including by those users who do not know how to use GIS technology processing. The GIS processing occurs automatically, without user intervention through a special GIS application based on describing the user-desired result. Results of the GIS processing are formed as an outcome of the users' selections of the most appropriate sample results and their answers to specific questions, automatically generated by the application of GIS in the process of dialogue with the user.

Keywords: geo-information technologies, emergency situation, management decisions, maps

1. Introduction

One of the most important aspects of life in modern society is the prevention, adoption of measures to mitigate and eliminate the consequences of various emergency (crisis) situations. According to the Federal Law of the Russian Federation No. 68-FZ, "an emergency situation is a situation in a certain territory that has developed as a result of an accident, a dangerous natural phenomenon, catastrophe, natural or other disaster, which may cause or have caused loss of life, damage to human health or the surrounding nature, environment, significant material losses, and violation of the living conditions of people" [1].

Emergencies are characterized by their diversity, the presence of exposed people or people affected by them, significant economic damage and environmental hazards, a large number of organizations and professionals involved in emergency response, a wide range of tools that are involved in preventing and eliminating emergency situations, which occur within a certain area, where the need arises for the rapid movement of people, goods, and equipment [5]. This makes a spatial aspect of crisis management most important and determines the primary importance of spatial information (geo-information).

2. Materials and Methods

As of today, geo-information is used in almost every sphere of the economy and social life throughout the world, and the areas, types, forms, and scales of its use are constantly expanding. Responding to the

new needs of society in the European Union, at the suggestion of the European Commission, a system was created – the Global Monitoring for Environment and Security (GMES). This system aims to create basic and additional services for emergency management. The efficiency of such services will depend on timely quality maps for situational analysis and visualization, modeling and interpretation of processes. Today, the GMES works with four main types of maps, such as early warning cards through emergency situations, reference maps, damage assessment cards, and thematic maps [2].

In Russia, there are also requirements for moving EMERCOM units to a higher level of public protection. Elimination of the consequences of emergency situations, as well as prevention of their occurrence should be carried out using high-tech monitoring and forecasting of emergency situations, such as using the space and aviation equipment, preventive measures for early warning of the population about possible emergency situations, as well as evacuating the population from dangerous areas [3].

The provision of these new requirements becomes possible only with a proper geo-information support of management decisions, an availability of appropriate geo-information for situational analysis and visualization, modeling and interpretation of processes. Persons involved in decision-making in humanitarian crises, natural disasters or man-made emergencies need electronic and digital maps. These maps should provide and display information in real time mode. This new paradigm is valid worldwide, and it requires new cartographic knowledge based on using the latest technologies.

The importance of spatial databases is rapidly increasing, so both the location and time become the best ways to detect and describe information. This is due to the fact that many data sets have their own "fingerprints" in the space and in time. Therefore, the location is an important basis for finding relevant information on the Internet and other distributed resources.

3. Results

The geographic information systems appeared half a century ago. Their development was constantly accompanied by an increase in the number of GIS tools and a general complication of the entire system. In the course of the carried out classification of GIS according to the criteria "functionality" and "accessibility for the unprepared user", 4 main groups of GIS were identified (Fig. 1). An untrained user is a person who uses GIS to solve his problems, but does not have knowledge of geoinformatics. For untrained users, a basic GIS functions are usually available for use, but they cannot work with the complex tools of professional GIS.

The first group includes professional systems, which are installed on local personal computers of users who have ample opportunities for carrying out a GIS analysis (for example, MapInfo Professional, ArcGis, etc.). The source data for processing can be located both on the userɔs computer and on external remote servers. A prerequisite for working with such a GIS is the presence of special knowledge in the field of geoinformatics of the user, so the number of users of such systems is not large.

The second group includes local systems. These are those applications that are installed on users' personal stationary or mobile computer devices that have a basic set of functions (map navigation, information and reference information, simple tools for creating your own data). Most often, this group includes reference GIS, cartographic data and reference information which is stored on the user's computer or on external media (CD, DVD). The functionality of such systems is many times less than a professional GIS. But thanks to the restriction of the functionality of only the basic functions, such GIS is more accessible to untrained users.

The third and fourth groups include network GIS applications running on client-server technology. Online GIS is an online application (service) with a basic set of functions. They provide a user with the same capabilities as the GIS from the second group. At the same time, thanks to the Internet, the number of users of such systems much more.

The fourth group includes server professional systems, in which a GIS application is hosted on a server, and the users are provided with basic functions and GIS analysis functions via a computer network. In this case, users are specialists in the field of GIS.

Thus, at present, unprepared users who do not have special GIS training can use only the basic functions of geo-information systems from the second and third groups, and have very limited opportunities for carrying out GIS analysis.

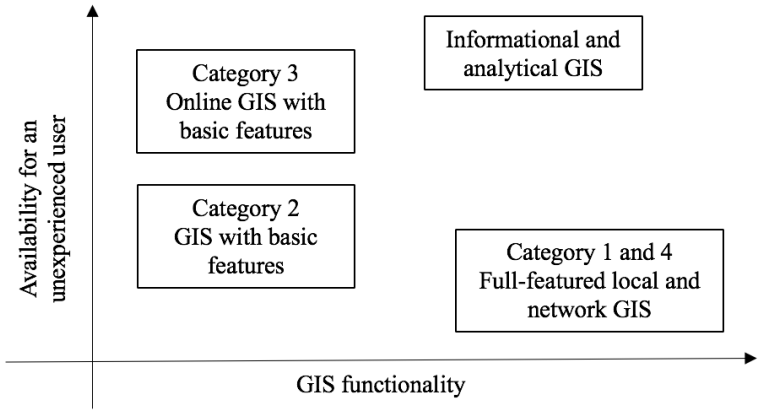

Fig. 1. The GIS classification.

To fulfill the requests of untrained users, we proposed an instrumental reference and analytical geographical information system (ISA GIS), which we assigned to a completely new fifth category in the GIS classification [4]. In connection with the distribution of network technologies, the GIS developed by us can work using a client-server technology and interacting with a user via the Internet. To work with this system, a user only needs an Internet browser. Installation of additional software on the user's computer device is not required.

Consumers with GIS-information solve a variety of problems and many do not have experience in working with GIS-technologies. Therefore, despite the wide distribution of geo-information tools in the professional environment, for most managers they are not familiar, or working with them requires a special training.

The ISA GIS will allow managers, without any particular difficulties typical for professional GIS, to work with geo-data and analyze the necessary spatial information.

At the same time, today there is a noticeable increase in interest in working with spatial data of non-professional users, i.e. the users who do not have the skills to work with geodata processing systems. There are many examples that show a great importance of geo-information in the life of any person. The simplest spatial queries are related to the geographical search of the desired object in a certain area.

4. Discussion

Everything said above tells us that the complication of geo-information systems and the increase in their capabilities are accompanied by an active increase in interest in GEO systems among non-professional users. There is a simplification of the ways of working with information. Such information systems begin to be created, with which not only specialists can work, but also users without special training.

The developed instrumental reference and analytical GIS is a distributed information system, in which the role of a developer (as system administrator) and the end user of the product (service) are singled out separately. The developer (system administrator), as a rule, knows what circle of users and tasks the system is focused on. The developer (system administrator) creates system content (content), chooses in which form and how information is stored, and also how the transitions between information blocks are organized.

5. Conclusion

The ISA GIS is used in conjunction with the Internet resources, forming an effective tandem that covers the needs of society for information in a systematized, selected for the intended purpose, sufficiently

long-term information in its significance. The amount of this information should not be limited and should represent a certain time slice of the state in a particular subject area. The information as a whole is fairly homogeneous in terms of reliability, accuracy and reliability, since it is professionally analyzed in the process of developing this system.

Thus, the modern geo-information technologies, together with new forms of geo-information, can more effectively participate in the processes of early warning and dramatically reduce the response time to emergency situations, improve the accuracy of calculations and the effectiveness of using forces and means. Hence, the most important task of the geoscience complex for the coming years is deep penetration into this area and expansion of the scope of geo-information use in emergency management processes.

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